The BIG Tutorial

for those new to

747-400 Precision Simulator v 1.3a

by Brian Cowell

with additional material by

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Version 1.01

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Introduction

This Tutorial for Precision Simulator version 1.3a supersedes the earlier one for version 1.2c. I have received numerous requests for an updated version, and so here it is (at last ☺).The main differences are the obvious ones: it attempts to include some of the changes and new features introduced by 1.3 and 1.3a, although some of those changes (notably, the numerous airline configurations) also make a Tutorial writer's life harder. But the most significant difference is that this time I have been assisted by Hardy Heinlin during the writing process, so that hopefully it is more accurate than its predecessor (but if not, then it's certainly not Hardy's fault!). My very grateful thanks go to him for all his hard work, and especially for his superhuman patience in answering some of my more näive questions.

The rest of this introductory section is similar (albeit with a few differences) to the one in the earlier version — just a warning for those who have seen it before ☺.

There are many checklists and Tutorials available for Precision Simulator, and so the question has to be asked — why another one?

In my professional life, I'm sometimes involved in trying to teach complex technical subjects (specifically, to do with the design, installation, fine tuning, repair, disaster prevention, care and feeding of large computer databases) to people who are technically adept whilst nonetheless being relatively new to concepts such as the ones I am trying to present. I am therefore especially conscious of just how difficult it is to explain complex sets of technical operations, and also just how easy it is to think that you've understood something — only to discover, sometimes much later, that in fact you haven't.

When I took up PS1 (a little while ago, now), I therefore took careful note of the things which I found difficult at the beginning, knowing full well that in time I would completely forget the problems I had experienced. For example, the fact that PS1's excellent reference manual (even better in 1.3!) doesn't explain absolute basics such as the overall scope of what you are seeing when you first look at the PS1 cockpit layout is something that only bothers you for the first half hour or so — but which bothers you quite a lot during that period! And there were many other examples of things which rapidly became "obvious" only after I had struggled for what seemed an unreasonably long time.

So the idea was born that my small contribution to the PS1 community (a wonderfully helpful and friendly bunch, incidentally) might be a sort of disposable Tutorial — one which a beginner could work through carefully for the first few times that they used the simulation, then revert to using the (now standardised) checklist in Appendix 7 or Hardy's manual once the basic concepts were in place, only referring back to this text in case of need. Occasional comments in the forum of the Aerowinx web site (`http://aerowinx.com`) from people who had bought PS1 only to find its complexity too much so they left it at the back of the cupboard increased my suspicion that the gradient of the initial learning curve might be too steep for some to climb, and also my hope that this sort of verbose Tutorial might prevent the PS1 **C**D from ever making its way into the cupboard in the first place.

(I have just realised, on reflection, that the 'cupboard comments' seem to have disappeared from the forum in the last year or two: since this introduction was first written, in fact. If by any chance this Tutorial — or, rather, its predecessor — has had anything to do with those disappearances then I would be very happy).

Inevitably, trying to explain everything which might be helpful takes a lot more words (and a lot more work) than writing a guide for the more experienced. But since the last professional textbook which I wrote came out at 140,000 words, writing this guide wasn't too hard at half of that (about the length of the average novel), although I little realised how long it was going to take me (the more you write, the more you need to explain, and to cross-check . . .). Anyway, the result is in front of you, and I hope that you find it useful, and that it enhances your Precision Simulator experience.

I have had to assume that the reader has acquired *some* background knowledge of aviation matters — so I have taken a reasonable knowledge of the MicroSoft flight sim as being a necessary minimum. This enables me to concentrate on the more PS1-specific things without having to keep breaking off to explain what flaps are, what V1 means, and so on. There are many resources for obtaining that level of information, so hopefully its absence should not prove a hardship.

Readers from other countries (I'm thinking principally of the U.S. — I used to work for an American Company and spent some time in the States so I'm especially aware of the extent to which we are "divided by a common language" ☺) may find occasional surprises with the spelling in this document. Those of us who speak English in its original form also have non-American spellings for words like "centre" and "routeing" and we speak of an "aircraft" rather than an "airplane", and so on. But then I've done the vast majority of my real-world flying in helicopters where the wings go round in circles and the Captain sits in the *right*-hand seat — which probably means that I'm confused anyway. So although I am writing this in England, hopefully those who are used to more exotic variations of the English language will be able to cope ☺.

Just before this Tutorial hit the streets, Hardy released the 1.3a upgrade, and it is assumed in this Tutorial that it will have been applied. There are a few minor occasions where the actions to be taken would be different depending on which version is in use, and where possible I have made reference to these differences in the text.

On the tiresome-but-necessary legal side, I retain the copyright in this material, which is entirely and exclusively for the personal use of licensed users of PS1 only; and the usual FreeWare caveats apply:

- No one is allowed to make any money from this (it may not be used in any CD collections, and may not be uploaded to a BBS or web site without my written permission — which will in no case be granted if a charge is made for access).

- You read/use it at your own risk — I don't warrant that it's fit for any purpose whatsoever (except possibly occupying disk space).

- Therefore no responsibility is accepted if you think it has caused any harm whatsoever — to you, your computer, your marital status, mental stability, or *anything*.

- The whole zipped package must be passed on complete — unedited and unaltered — and the passwords must not be divulged to *anyone*, since all legal users will possess the means to obtain them (the PS 1.3 manual).

- Finally, the inevitable disclaimer: this Tutorial is under no circumstances to be used for real world flying. (Would anyone really be crazy enough? Still, I suppose it has to be said).

Outside of that, I hope you have fun!

Finally, there are a number of people to whom thanks are due, since this Tutorial could not exist in its present form without their help.

First of all, and most of all, I must express my overwhelming thanks to Hardy Heinlin who has been kind enough to read through *all* this stuff suggesting many changes and improvements, and correcting my mistakes ☺. With his permission I have included many of his invaluable insights in the text, and I am deeply grateful to him for his kindness, and, of course, for the incredibly detailed simulation of the 747 which he has placed at the disposal of all of us.

I am also greatly indebted to Ian Riddell and Jeroen Hoppenbrouwers for their comments on the previous version of this Tutorial, which have added considerably to the comprehensiveness of the present one, as well as its accuracy. Thanks are also due to Bertil Gullmar of Team FSS for his permission to reproduce the charts in Appendix 14; to Adrian Smith, ATCO, for his kind assistance with regard to UK ATC procedures and Transition Levels; to Philippe Coraboeuf for his Glasgow SIDs and Heathrow STARs (contained in the distributed files); and to Rets for permission to incorporate his comments about Abnormals into Appendix 12. Finally, I also proffer my sincere thanks to the many PS1 forum contributors on the web site, who have also, over the years, enhanced my understanding of this very remarkable simulation.

But I need hardly add, of course, that any and all mistakes remaining are entirely my own.

Brian.

EGLF [1]

August 2001

P.S. Version 1.01 is released mainly to implement password changes and correct a couple of minor typos. Sadly, since the original release, the events of September 11th 2001 are continuing to affect the aircraft industry worldwide. Also, Team FSS are currently no longer able to supply charts, following various “copyright and other issues” with SAS, and so this resource is no longer available to us.

B.C.   March 2002

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[1] You won’t find EGLF (Farnborough, Hampshire, England) in the PS1 database (unless, of course, you add it yourself as I have done ☺): it’s an airfield which was run originally by the Ministry of Defence but which now serves mainly civilian aircraft (mostly business jets, as those of us who live on the approach can testify). It also (during part of the writing process, in fact) hosts the Farnborough Air Show, which showcases civilian and military aircraft from all round the world, with the result that 747’s, and even Concorde, have visited from time to time. Because of the close proximity of Heathrow and Gatwick — with RAF Odiham and private flying at Blackbushe even closer — entry to and egress from Farnborough are entirely controlled by ATC, so you’re not going to find many useful SIDs and STARs for it, either — although improved navaids are currently under construction.

New readers start here

Learning to operate the many systems of a 747-400 is not a simple matter.

I make this blindingly obvious statement up front because there *have* been those who seem to think that it's only going to be slightly more difficult than, say, learning something like Microsoft's Flight Simulator, and that they can completely master it in a week or so. This, let me assure you, is not very likely — unless, of course, you are fortunate enough to have considerable experience of aviation in general, and the 747-400 in particular, before you start.

But then much of the joy of PS1 version 1.3a derives precisely from the fact that it *is* a very complex simulation, and that in becoming familiar with its many facets you will necessarily extend your aviation knowledge. There are many people who have used the Aerowinx forum to express their great pleasure at mastering one or other of the technicalities of 'flying' the simulated 747-400s (plural, because of the many different configurations included, as used by different airlines), and the enormous feeling of satisfaction when it all starts to make perfect sense.

The function of this Tutorial is simply to get you started on this rewarding road.

So it assumes that you already have a 'Microsoft Flight Sim' level of aviation knowledge (otherwise this treatise would be even longer than it already is). It aims to walk you gently through the whole process of 'flying' with PS1, up to the point where you are ready to start some of the more advanced stuff such as enabling malfunctions and so on (flying PS1 without malfunctions is a bit like playing Backgammon without using the doubling cube — it's a similar (and simpler) but fundamentally different experience). But even attempting a gentle walk-through does mean that in order to serve a wide audience this guide needs to also cover all sorts of aviation side-issues along the way, from the format of TAF and METAR codes through to how to correctly read an approach plate, from details of the various automatic flight modes through to how to program your own SIDs and STARs for an airfield not currently in anyone's PS1 database but (potentially, at least) your own.

Which gives me, the author, an interesting series of problems to solve. Primarily, I am aiming to make the learning curve as smooth and gentle as possible — although this is not going to be easy since each reader brings with them their own individual combination of areas of expertise and, er, absence of expertise. So what I've tried to do is to make the main text follow a linear path from preflight to shutdown, keeping as much as possible of the supplementary background knowledge and explanations tucked away in the Appendices and the occasional (!) footnote so that they don't hold up the action. But, as an author, I know all too well that there are those who never read introductions and who never read Appendices. All I can do is to suggest, in a very encouraging and friendly way, that at some point you should consider scanning through the Appendices — there may be something in there which you thought you knew but didn't, or perhaps knew incompletely. It's sometimes worth scanning through a lot of dross to discover an occasional nugget of pure gold ☺.

There is, of course, the argument that this Tutorial is unnecessary. Many aviation experts have expressed the view that the superb handbook which comes with PS1.3 is almost as good as the one which comes with the real aircraft. So why, then, do we need this Tutorial? Only because there's a big difference between a reference manual and a learning guide.

This is (or tries to be) the learning guide. This is for those of us who need some supplementary information because we do other things for a living, and whose interest in aviation matters provides us with a refreshing change from the things which we do every day just for the money.

It is dedicated to all those who love aviation and are willing to invest some time and effort into pursuing that interest in depth — for which purpose PS1 is superb.

The layout of the Tutorial

All of which brings me (eventually, yes I know — I'm sorry but I just wanted to explain why I've done it as I have) to the organisational pattern of the Tutorial.

Before getting into the serious business, if you've just bought PS1 you'll want to have some fun. It is disappointing in the extreme to have acquired this tremendous software and then not be able to get the aircraft airborne for hours or even days — but fortunately in version 1.3 we have *videos*. So to watch an expert do it (it's fun to see what it looks like, even if you don't follow everything that's happening) fire up PS1.3a, press Escape to return to the Instructor's Page, take the option to Load a Video and watch video ZZZZ0006 (and the ones that follow it, too, if you wish).

You'll need a rough idea of what you're looking at, so the picture on the next page identifies a few of the main elements of the PS1 console as it appears on your computer screen. Some parts of it are not visible in that screen shot, though — the EFIS [2] control panel, to the left of the scrolling MCP components (on the glareshield at the top of the screen) and some more stuff on the right of that scrolling panel; all the overhead panels (which overlay the ND when they are displayed); and the full-size CDU with its keyboard (which overlays the lower EICAS and part of the upper). Soon you will become intimately familiar with every detail of these panels, since they are designed specifically to present a tremendous amount of vital information to you in a very concentrated format.

One little tip when you're watching the videos, incidentally — you can pause a video using your *keyboard* "Pause" key (*not* the 'P' key as used when you're working with PS1 normally). Restart it again by pressing the space bar (or any other key). [3]

This video feature in version 1.3 enables you to see exactly what the simulation looks like, and provides you with some splendid examples of the way in which certain techniques should be applied; but you're bound to want to try it yourself, too. So I've provided a sort of prequel/sequel, which makes it as easy as possible for you yourself to ferry your aircraft from Gatwick to Heathrow— "just a simple up and down" as golfing commentators are wont to say (but only when they are not the person having to do it). This should enable you to get that great feeling of satisfaction associated with getting your big iron bird off the runway and safely down again (hopefully, in one piece ☺).

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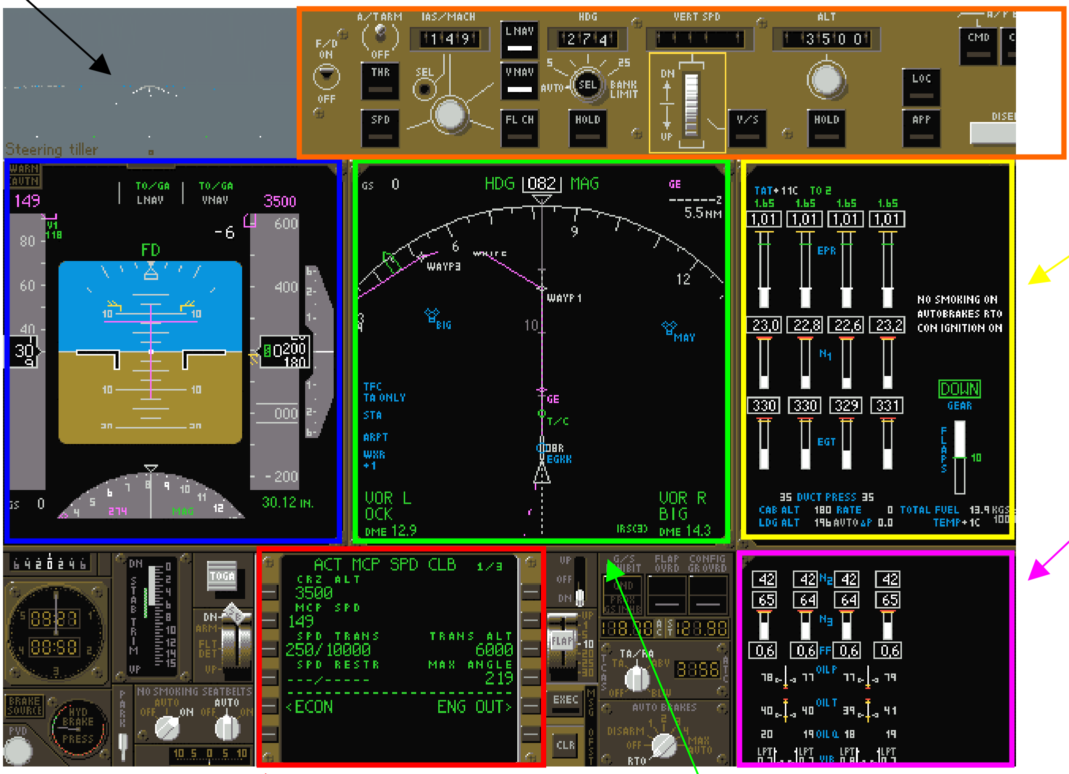
[2] To find where these acronyms occur in the PS1.3 manual, see the index which forms Appendix 11.

[3] Note also that there was a small bug in the video system in the first release of 1.3 (i.e. without the 1.3a upgrade) — each time you started the video player for the first time in a given PS1.3 session, you needed to press ESC and restart the video (to avoid an implicit mouse click as the video began).



Outside

Mode Control Panel (PS1 manual pp 55 - 60)

PFD = Primary Flight Display (PS1 manual pp 112 - 121)

Upper EICAS display

Lower EICAS display

CDU = Control Display Unit (smaller version) (PS1 manual pp 143 - 144)

ND - Navigation Display (PS1 manual pp 124 - 133)

One small prerequisite is that to be able to operate even the ferry scenario, you do need to acquaint yourself with the techniques for turning and pushing knobs, pulling levers, and so on. PS1 offers a rich variety of alternatives, so that most things can be done with either keyboard or mouse, as you prefer. The PS1.3 manual covers all of this on pages 11 to 17, and *you just have to know this stuff* or else you might be embarrassed to find that you can't control your Jumbo once you've got it into the air! So take the time to work through those pages before trying the ferry trip, or else your virtual insurance company will be sending the boys round to inspect the remains — or, worse still, *your* remains . . . . .

But then we get down to the serious business — the main bulk of the Tutorial.

The first thing would normally be your preflight. Before climbing up to the flight deck you (or someone) will need to have done a fair bit of planning, and although at first you'll probably use 'Situations' (INI files in the FREEZE folder) and routes which have been set up by someone else, you'll soon want to be able to set them up yourself. You don't need to worry about this immediately, however, since there is a Situation file provided for you just for this Tutorial — but sooner or later you *will* need information about pre-flight items, and it's all set out for you on pages 22 to 26 of the PS1.3 manual (and there is also some material about various aspects of this topic in Appendices 13 to 15 of this Tutorial).

So the first section of the Tutorial gets you from a "cold and dark" cockpit (i.e. the aircraft and all its systems have been completely shut down, and the engineers haven't even begun to prep the aircraft for you) through to waiting at the end of the runway for permission to take off. Those used only to Microsoft and similar simplified simulations will be staggered at the length of this section . . . . (And no, I am not going to be tempted to make any comment whatsoever about "As real as it gets" ☺).

The second section is therefore purely about flying: take-off, climb, cruise, descent, approach, landing — what it's all about, in fact — and also includes shutting down all the systems at the end.

Finally, we have numerous Appendices on various matters — mostly background information which you will need at some stage or other, but which I've separated out to avoid cluttering up the main Tutorial. Among these (Appendix 7) is a **C**hecklist which is a distillation of the one used in the main text, and which is also markedly similar to the one given in the PS1 manual and used in the 'Taipei to Guam' videos (ZZZZ0003 and following). The main differences are that Appendix 7 is not as terse as a 'real' checklist (it aims to be a sort of half-way house between the full text and the version in the PS1 manual, often giving you the locations of the controls until you're familiar with the cockpit layout) and that it copes with a few variations which are not, and would not be, explicitly dealt with in a 'proper' checklist. And, of course, you can print it out and make your own notes on it as you go along.

So now you know what's here, you can decide where to start . . . . or can you?
Just before we *do* get started — you should be aware that there are numerous possibilities available, owing to the flexible nature of PS1 itself. As mentioned above, as a beginner you will normally need to load a "Situation" (a .INI file from the 'Freeze' folder below the one where you installed PS1) which gives you a predefined starting point. The snag is, that this could put you anywhere . . . .

- It may be that you have a "cold and dark" scenario whereby you have to do everything: switch on the electrics, do all the preflight checks, kickstart the engines (I exaggerate, you're usually allowed to use autostart ☺ — except, of course, with some airline configurations that don't have it ☹), taxy out to the runway, and carry on from there.

- *OR* your Situation could place you anywhere from the totally cold and dark point right through to — well, just prior to landing, I suppose (at least, there's not much value in putting you *after* that point that I can think of).

So although Section 1 takes you through everything assuming a cold and dark start, your Situation file may put you at some intermediate point anywhere along the way — hence you will need to discover what that point is, and then carry out the checks remaining.

But a significant part of the learning process is to do with learning about the FM**C** (Flight Management **C**omputer) — and just as the Situation file can vary the amount of work to be done in the pre-flight phase, it can also include varying amounts of the FM**C** work having been done, too.

- You may have to do *everything* with the FMC, starting with entering the departure airport, and working right the way through to adjusting the tin mind's opinion about numerous aspects of your forthcoming flight.

- *OR* some parts of the work may have been done for you, leaving you to complete the rest.

Again, this guide assumes the worst case, and tries to highlight the things to check for, not least since the quality of the Situation and Route files available on the web varies somewhat (be sure to get a 1.3 version! Also be aware that the quality varies: some even exist on the Web which lock up PS1 when you try to load them).

So you can have every combination of possibilities in terms of the aircraft, combined with a similar range in terms of the FMC. No wonder it's a bit hard to know which way is up when you first encounter PS1! Unless, of course, you really do have a mind the size of a planet, or are a recently-retired 747 Training Captain — in which case there are a few questions I would like to ask you . . . .

Anyway. With all that in mind, *now* let's begin. Choose your starting point:—

- The ZZZZ0006 video, if you want to see how PS1 looks.

- The Ferry scenario overleaf, if you haven't flown PS1 yourself yet.

- Section 1 (the introduction to which starts on page 18) if you are working through waking up the various systems and doing the checks, then taxying out to the runway.

- Section 2 (starting on page 49) if you have a Situation file which puts you at the end of the runway ready for take-off —this section also concludes with shutting the aircraft down at your destination.

Have fun!

Ferry round the M25 [4]

The next few pages are intended to get you actually flying PS1 yourself as quickly as possible. Obviously, this requires a lot of things to be simplified and preset, and also that you more or less follow the instructions given without any explanations being offered until later in the Tutorial. But if you would like to get your new toy into the air as quickly as possible, then follow the instructions below. If you have superhuman self-control, of course, and would prefer to follow everything through in sequence, then turn straight to page 18 (“Your Situation”).

It can be discouraging, although inevitable given the sheer complexity of PS1, that it normally takes quite a long time before someone totally new to such a complex simulation can start to fly the 747-400. So just to give a flavour of the sort of thing which you are going to experience, this quick trip is intended to help you achieve a quick take-off and landing. Please bear in mind that to keep it easy, all sorts of simplifications have been made — notably the assumption that we’re the only plane in the sky; and also that no one will mind us taking a Jumbo jet over central London at 3,500 ft . . . . (!!)

But although I promise to try and keep this as simple as I possibly can, it will definitely help if you have checked out pages 11 to 18 in the PS1 manual (and perhaps Appendix 2 of this Tutorial) so that you know how to control flaps and speedbrakes, and handle the various knobs and levers which you are going to need, using the mouse and/or keyboard shortcuts.

The scenario is that we have to ferry a 747 from Gatwick to Heathrow, just up the road (but still something like two hours’ driving, if the M25 motorway is in its usual mood). Anyway, here we go.

Make sure that you have put FERRY13.INI (as included in the zip file) in the `Freeze` folder just off your PS13 folder, and fire up PS1. Press Escape, and on the Instructor’s Page click on “Load . . . ” (top left) and select FERRY13 from the list using the red right and left arrows as required, press OK, and then press the Escape key again to re-enter the flight deck.

You will find yourself sitting at the end of runway 08R at Gatwick, with some kind soul (your First Officer, presumably) having done all the departure and take-off clearance stuff for you.

Just before we get going, take a moment to note the Navigation Display in the centre of the screen [5]. See that magenta-coloured line? That’s the start of the route we’re going to take — we basically go straight ahead until we’re clear of Gatwick, then keep turning left until we line up with Heathrow’s runway 27R, and land. Nothing to it? We’ll soon see . . . .

The upper EICAS display (to the right of the Navigation Display) shows various items which you need to be aware of, notably the engine displays and, towards the bottom right hand corner, indications for the undercarriage (“Gear” in American parlance) and flaps.

The Primary Flight Display (to the left of the Navigation Display) has an electronic version of the artificial horizon with which I hope you’re familiar, together with the altitude on the right hand side (we're 200 ft above sea level here) and the airspeed on the left (we're not moving, but this display is driven by the pitot tube, and never indicates less than 30 knots). You may notice that at the top of the speed scale you can make out "V1 118" in green — this is our V1 speed, but you'll know when we reach it because the First Officer will call it out for you, followed shortly afterwards by "Rotate", which is your cue to start lifting the nose off the runway to generate a lot of lift from those huge wings. OK, *make sure Num Lock is engaged* and let's get moving!

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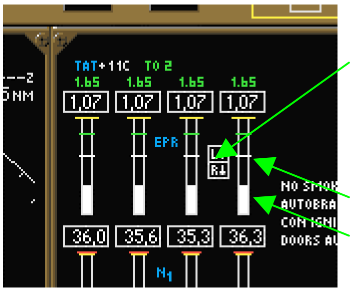
[4] The M25 isn’t an airway — it’s the M25 motorway which encircles London, popularly known (owing to its appalling traffic) as “the circular car park”.

[5] Also refer to the screen shot on page 8 for your ND, PFD, and the rest.



Move your mouse onto the engine indications on the EICAS display to the right of the Navigation Display: you will notice that little boxes indicate that the Left mouse button increases thrust, whilst the Right has the opposite effect. So hold down the left button, and the thrust starts to increase – but very slowly, so now *also* hold down the right button and you will find that it speeds up by a factor of ten. Wait until the indicator is about half way up the scale and then release both your mouse buttons. When the white fill catches up with the white line you have placed, press the large "+" key on your numeric keypad. Your F/O (First Officer) calls "Take-off power set" [6].

Now look at the runway which you can see in the top left hand corner — hopefully, you're moving along it at increasing speed. If you need to straighten up, drag the mouse off the bottom of the screen (you'll see "steering tiller" in brown at the bottom of the windscreen) and use it to drag the nose in the direction you want it to go (hold down the mouse button whilst you move the mouse — gently does it — try and keep the far end of the runway in the exact centre of the windscreen).

When your F/O announces "Rotate", hold down the "2" key on the numeric keypad until you see the nose starting to lift. Don't get it moving too fast, though — aim for about 2° a second — and don't exceed 10° nose up until you're fully clear of the ground or else you may drag the tail along the runway [7]. Then use the "8" key and the "2" key as required to stabilise the little white dot on the Primary Flight Display in the centre of the big magenta cross.

Now you need to do several things in quick succession (at this stage you can be forgiven for using the "P" key to pause, or even totally re-start the simulation, if things start to happen too fast):—

- Once your height starts to increase *and* a positive rate of climb is indicated, retract the undercarriage by pressing the "G" key *twice*.

- When you're passing 250 ft (as indicated by the Radio Altimeter figure in white, just above the top right-hand corner of your electronic artificial horizon) press "A" to turn on an automatic pilot. You should notice, if you have time, that the “FD” above the centre of the horizon becomes “CMD”.

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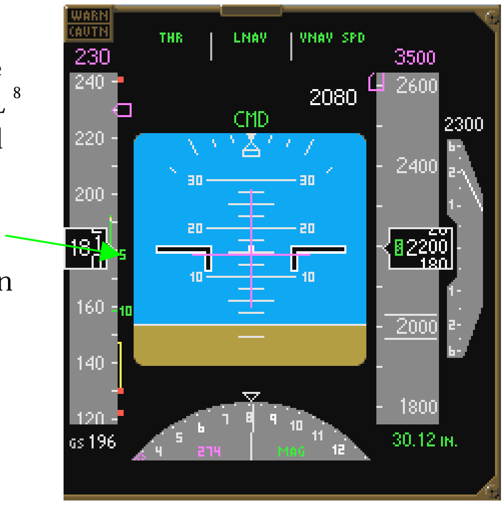
[6] Here, I had originally written ". . . the F/O confirms what you've done", but as Hardy pointed out:— "The F/O doesn't confirm what your hand is doing on the thrust levers (you know this yourself since you won't release your hand from the levers until V1). Actually, the F/O only confirms that the autothrottle has stabilised the engines exactly at the pre-programmed take-off power calculated by the FMC. While they are stabilising at the pre-programmed power setting, your eyes should be on the PFD and the outside view (hence the assisting call from the F/O).

[7] There's an interesting photograph in "Handling the Big Jets" by D.P. Davies which shows a 747 actually scraping its tail along the runway during Boeing's high attitude take-off tests. (That's high *attitude*, not altitude).

- Above 1500 ft (you will notice that the nose drops slightly and we begin to accelerate) start to retract the flaps (clicking on the flaps lever with the mouse or using <F9>) as your speed increases. It is this which is perhaps hardest to explain, so I’ve included a screen shot which might help a bit.



Here we see the Primary Flight Display as we start to increase speed (we’re shown as doing 181 kts and passing 2,200 ft MSL [8] with the Radio Altimeter showing us as 2,080 ft above ground level).

But I would mainly like to draw your attention to the green 5 just to the right of the “181” — use this as your guide for when to bring in the flaps. As you can see, the figure “10” (also in green) has moved downwards and “5” is now more or less opposite the centre of the display — this is the time to order flaps 5 (left click once with your mouse on the flaps lever or press <F9>).

Similarly, order flaps 1 as the speed increases and the green flap manœuvring speed indicates that it is safe to do so, and finally flaps up as your speed safely exceeds 220 kts or so.

See page 114 of the PS1.3 manual if you’re not sure about the flap manœuvring speed indications: Appendix 10 of *this* Tutorial also discusses these matters, describing both manœuvring and placard speeds (the topic has to be simplified here, just for the moment).

OK, that’s the first busy bit taken care of — but you can’t relax just yet.

Once you’re sure that the gear is fully up (i.e. the indication has disappeared from the upper EICAS display) press G once or click once on the handle to return it to the centre position. This depressurises the hydraulics (although it’s probably a bit of a luxury for this short trip).

Using the mouse again, click on the CDU to get the larger version, and then click on the LEGS button. Now you can see each leg of the trip we are making — although normally there could be hundreds of miles between each one, here we are generally seeing just a few NM (Nautical Miles).

You may notice that when we get near the point where the course turns left, the plane banks left to follow the magenta line on the ND. If you’re thinking this is too easy, you’re right — you’ll have a bit more work to do when we get close to landing . . . .

OK, you can relax for a little while and enjoy the flight: the aircraft should now be cruising at 3,500 ft, and be doing 250 kts (the legal limit below 10,000 ft, although because a really fuel-laden Jumbo couldn’t fly at that speed without stalling, the rules are sometimes relaxed a little for us heavies).

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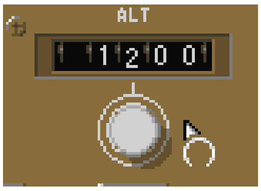
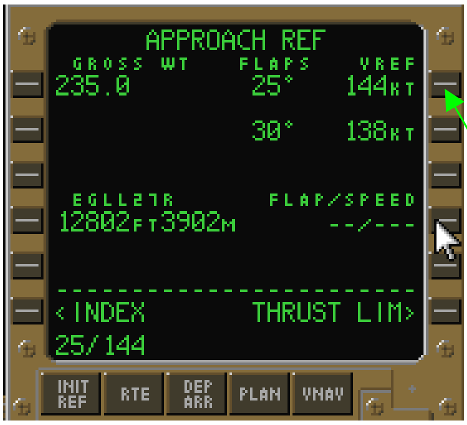
[8] Mean Sea Level. That’s Mean as in ‘average’, not in any American sense of the term . . . . ☺

As the flight gets near the point shown on the ND and Legs page as WAYP3, it's time for you to begin to get *really* busy . . . .

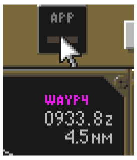
First of all, you need to change the 3,500 ft indication in the MCP window to be your altitude at the outer marker of Heathrow's runway 27L — 1200 ft. To do this, position the mouse pointer as shown in the screen shot (right) and left-click until the value in the ALT window is reset to 1200 ft. *You won't descend yet*, since you're under the guidance of VNAV, which is following the instructions on the LEGS page which show your speed and altitude to be 250 kts and 3500 ft. But unless you change the ALT value on the MCP now, you'll not descend as you want to, later on.

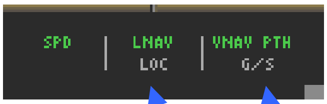



APPROACH REF
GROSS WT FLAPS VREF
235.0 25° 144KT
30° 138KT
EGLL27R FLAP/SPEED
12802FT3902M --/---
< INDEX THRUST LIM>
25/144

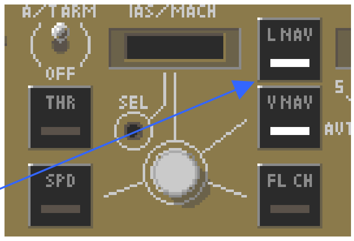
When you've passed WAYP3 and WAYP4 is next, it's probably time to set your approach speed. This involves getting the large version of the CDU on the screen, pressing the shift key so that the keys turn yellow, and then pressing the INIT REF button at the top left hand corner of the keypad to bring up the APPROACH REF page. We're going to land with flaps 25 today, and so we need to tell the Flight Management Computer about it. Clear the scratch pad line of any existing messages if necessary by pressing the Backspace key, and left-click the Line Select Key just to the right of 144 which transfers those values of flap and speed into the scratch pad (bottom left you can see that the figures "25/144" have been copied there). Now left-click on the LSK next to "FLAP / SPEED - - / - - -" where the mouse pointer in the screen shot is (above),to transfer the values into that line, and you've done it. Press the LEGS button again, and then press the shift key to turn off the FMC input mode (the keys should turn from yellow back to grey).

OK, you will be getting close to WAYP4 by now, and if so click on the APProach mode button: this will seek out the localizer and glideslope signals from the ILS beams at Heathrow 27R so that we can hopefully follow them right to the runway threshold. The picture on the right also shows that WAYP4 is the next waypoint, and that it is currently 4.5 nautical miles away from us. (Notice that since all the glareshield components scroll as you move your mouse left and right, the APP button may not be over the top right-hand corner of the PFD in your case!).



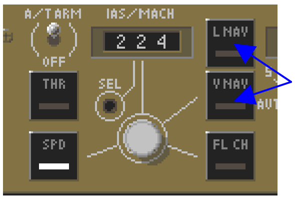


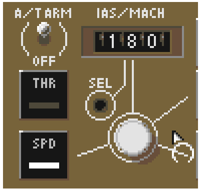
Even though you've requested APP mode, you should be aware of this important distinction — APP mode is only *armed* at present. It cannot be *engaged* until we are actually on the beams, and so the indications at the top of the PFD show LOC (Localizer — left/right component) and G/S (GlideSlope — up/down component) modes in *white* still, to show they are armed. But we still have LNAV and VNAV modes engaged as shown in green on the top line of mode annunciator display, and if we look at the buttons on the glareshield this is confirmed by the light in the LNAV and VNAV buttons there, too.

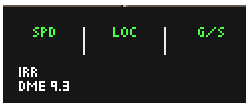


Two other jobs which you could get out of the way now — right-click to the right of the Autobrakes knob until it is set to 3 (or press the "." key four times); and also right click once on the speedbrakes lever (or press <F8>) so that it moves down to the ARM position. Both of these will only take effect when we touch down: the first will help us achieve steady controlled braking and the second will kill much of the lift from the wings to set us firmly on the runway.

As we pass WAYP4 and get near to the centreline of our target runway, various things start to happen. The speed starts to decrease, and also you may notice the diamond-shaped 'bugs' on the artificial horizon begin to move as they respond to our passing through the Localizer and Glideslope beams. Now we need to start getting quite busy again. Normally, you would exercise your skill to co-ordinate running out the flaps in stages as you decrease the speed — but we're alone in the skies today, so we're going to cheat. (You'll learn all about doing it properly later on, in the main Tutorial). But just this once, when you're established on the ILS you'll lower the gear, reduce your speed, and select flaps 25. (Have you ever been on an aircraft approaching the runway and suddenly felt a marked deceleration as though the aircraft has quite suddenly slowed down? That's landing flap going in). Then all you need to do is to keep reducing the speed using the MCP until you achieve 144 kts — ideally about a mile before the Outer Marker [9], but today there's no problem if you should get there sooner.







Once the Localizer and Glideslope beams are captured, the 'armed' modes become 'engaged': watch also for *both* LOC and G/S being annunciated in green on the PFD. This means that you are fully established on the glideslope (i.e. the diamond is centred on the right hand side of the PFD) *and* on the localizer — so you should press G to start the gear moving down into position. The extra drag will help to start reducing your speed, too. When the light in the VNAV button went out the SPD button lit up and the current speed (which will probably not be the speed shown here) was put into the IAS/MACH window. This means that **you now need to control the speed,** so left-click to the right of the IAS button as shown (right) to initially select 180 kts. Once the undercarriage is "Down and green" and your speed is below 200 kts, right-click on the flaps lever (or use <F10>) until you have commanded your flaps to be extended to flaps 25 (it will take a little while to achieve this). LOC and G/S modes should now be engaged (as shown in *green* on the PFD, where you can also see (bottom left) the DME associated with Heathrow's IRR ILS, which will tell you exactly how far you have to run). Your aim is to achieve flaps 25 and then to reduce the speed to our approach speed of 144 kts by the time you cross the Outer Marker shown on the Legs page and the ND shows 'D7.5', i.e. 7½ nautical miles DME (Distance Measuring Equipment) from landing.

Once you have your gear down, and flaps coming down, and are starting to reduce your speed, right-click to the right of the ALT knob and reset the altitude in the window to 3,000 ft. This is in case you need to do a missed approach (although the real missed approach for this runway is not programmed, just a climb straight ahead to 3,000 ft). You won't start to climb at this point, since the Autopilot currently has control of the aircraft and is following the glideslope — check the G/S mode annunciation on the PDF [10]).

The *good* news is that now all you need to do is be sure to achieve 144 kts by the time the DME indicates 7½ miles to run, since this will be a Cat II AUTOLAND. Once you've achieved your landing speed you can relax and watch as the computers handle the entire landing sequence for you as the electronic GPWS voice calls the heights on approach. But as soon as the wheels are rumbling along the runway, there are just a couple of final things you have to do.

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[9] Hardy points out: "Always try to make a "stabilised approach", i.e. everything must be configured by the time you are over the OM. This is especially important in a Low Visibility approach."

[10] Appendix 5 contains information on the various flight modes.

Press the backspace key to engage reverse thrust as soon as you touch down [11] (be sure that you're not still in **C**DU entry mode, with its buttons illuminated in yellow), but keep your finger poised to press it again to *dis*engage reverse as soon as your F/O calls "80" (knots). Monitor the extension of the speedbrakes by watching the lever deploy (you armed them earlier, remember?) and watch with relief as the application of the autobrakes brings you to a halt on the runway.

But it's OK — we're the only plane in the sky today, right? So if you want to park on Heathrow's runway 27L just this once, make the most of it 'cos it doesn't happen often ☺ . . .

Having completed your first landing, press Escape to return to the Instructor's page.

Well done!

Phew!!

But now it's time to learn how to do it properly, which is what the rest of this Tutorial aims to do. Before you start your next flight (from Glasgow back to Heathrow again) you will find that someone else has flown your aircraft to Glasgow and completely shut it down, so that you will need to wake the beast from its slumbers before bringing it back to Heathrow, and then return the compliment by shutting it down completely when you reach the gate.

As the old books used to say after setting the scene: "Now read on . . . . "

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[11] You may wonder (I certainly did) how to judge the correct moment to engage reverse thrust. Hardy, of course, has the answer: "In a 747 cockpit you can't hear the tyre screech when the wheels are touching down. So your "touch down" indications on the 747 are the following: you can hear the armed speedbrake lever motor moving to the UP position; and on the PFD the red stall speed tape will be removed upon touch down".

Your Situation

You have to start somewhere, so until you reach the stage of planning your own flights you will need to load an appropriate Situation. The one I've produced for this exercise is called GOWLHR13 (this puts you in a cold and dark aircraft at Glasgow). If you haven't already copied the GOWLHR13.INI file to the Freeze subdirectory of the directory in which you loaded the PS1 software, then please do so now. *If you have checked the option in Preferences on the Instructor's Page which says "Always keep current configuration when loading situation files", then you need to be aware that this Tutorial assumes that its native (British Airways) configuration will be used, and hence you may find differences in equipment (e.g. engines!) and options which are fitted to the aircraft.*

I'll mention here one very simple point which might save you a few tears, and curses — *beware of using the PAUSE control whilst you're following this or any other checklist*, or you may **forget** that you are Paused and then really inexplicable things will happen — engines won't light up or whatever and you can go crazy trying to figure out what's wrong . . . . True, if you're *not* Paused then whilst you're puzzling over where to find an alternate flap mandraulic pressure override release valve (or something) precious fuel is burning away in the APU [12], your departure time is getting closer, ice is forming on the wings, and your dinner date is looking increasingly doubtful — but these things are an excellent motivation for you to learn how to get through this checklist quickly but without sacrificing any accuracy ☺.

Cockpit familiarisation

OK, if you're on the Instructor's Page it's time to take the **C**ontinue Flight option (top right). I'm assuming here that you're into a "cold and dark" scenario: if not, jump to the appropriate place in the stuff which follows.

Ah, but . . . .

Those *totally* new to PS1 have an immediate problem — if they have to go to the Electrical panel, say, where is it? A brief word about the layout might be useful at this point (if not, skip to "Flight Preparation: let's get on with it" — the following section, overleaf), since this isn't immediately obvious from the reference manual. In that manual, however, (pp 11 - 18) you *will* find how to turn dials and push buttons using mouse or keyboard, and as I said earlier *you need to be totally familiar with all that stuff before going any further*.

You're looking at a somewhat repositioned (to fit into a P**C** monitor shape) view of the vital elements of a 747 **C**aptain's instrument panel [13], with a small view of the outside world in the top left hand corner. You will hopefully recognise the Primary Flight Display (PFD) left centre, with the glass equivalent of an artificial horizon (and much, much more, see page 112 and following in the 1.3 manual: note, by the way, that the PS1 manual is arranged mostly in alphabetical order, perhaps with some surprises for those unfamiliar with standard aviation terminology — the engines, for example, are to be found under P for Power Plant). The large display in the centre is the Navigation Display (ND) (p 124ff), and to the right of that you will find the primary engine indications and upper EI**C**AS panel.

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[12] The Auxiliary Power Unit will be discussed on page 24 (when we power up the aircraft).

[13] See the screen shot at the top of page 9.

Below the upper EICAS display is, logically enough, the lower EICAS display, controlled by the eight glareshield buttons in the top right hand corner (these may not be visible until you navigate to them using mouse or arrow keys), and the information screens associated with each button are referred to as 'synoptic views', or simply 'synoptics'. The buttons are part of the glareshield components (stretched out just below the windscreen on the real aircraft), and in PS1 the glareshield is a scrolling display which unfolds under your mouse as you navigate it. To the left of the buttons you have the autopilot controls, in the area more formally known as the Mode Control Panel (some of these controls are linked to the operations of the FMC [14] — those from a MSFS environment will have a few surprises in store) see pp 55 - 60 in the 1.3 manual. And to the left again you will find the EFIS controls (pp. 111 and 122, 123) which affect the ND and PFD. (Are you getting the hang of all these acronyms and other terminology yet?).

At the bottom of the screen the most important component is the CDU interface to the FMC (pp 141 – 179 in the 1.3 manual) with its associated display buttons and (in the larger version when you click on it or press the Tab key on your keyboard) keys. It is vital to remember that communication with the CDU is subject to special rules — (a) the shift key is used to toggle the CDU for input (the Control Display Unit buttons light up in yellow to show that you are in FMC input mode) , and (b) all numbers must be entered via the numeric keypad and *not* using the numbers along the top row of the alpha part of the keyboard. Also in the area adjacent to the small CDU buttons you will find other stuff such as controls for flaps, speedbrakes, and autobrakes; comms radio and transponder settings; and the undercarriage lever (another difference for those MSFS folks accustomed to the MS standard panels is to be found here — there is a *third position* (off) apart from up and down!).

However, so far hidden from view we have lots more stuff — on the *overhead* panels, which you can see by clicking on the ND. I will simply list these in sequence from left to right, since they are easy to find with the mouse: EEC and IRS; Electrical; Hydraulics; Fire; Engine start & fuel; Pneumatics; and Miscellaneous (which contains items from a number of places in the cockpit which didn't fit anywhere else and so are brought together here: all the other panels correspond largely to overhead panels on the real aircraft, except insofar as the fact that here they are spread out horizontally).

One other issue regarding the Miscellaneous panel might as well be mentioned now — be aware (as they say) that *some of the switches there have two positions and some three*, so learn how to distinguish their setting correctly by eye. But the largest change with the 1.3 version of the simulation is that some items on those panels are Airline-specific, and hence will appear in some configurations and not others, or perhaps the off position may be either up or down depending on configuration. As already mentioned, this Tutorial assumes that the BA configuration will be used.

Whilst on the topic of configuration differences, UK users (for example) need to be aware that UK keyboards vary slightly from both German and US keyboards — so that the GPWS

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[14] Hardy comments: "Actually, the only links to the FMC are the LNAV/VNAV switches and the Autothrottle functions. The other switches are basic MCP modes in a separate unit. So, the Autopilot/Flight Director can be programmed either by the MCP (made by Rockwell-Collins) or by the FMC (made by Honeywell). They are two independent 'tool boxes' for the crew to control the aircraft. The MCP modes (V/S, HDG SEL, ALT HOLD etc.) can quickly and easily be adjusted while the pilot's 'head is up'. The FMC functions, on the other hand, provide more automation, however require more complicated keyboard work and monitoring, i.e. 'heads down'. In other words — for each situation there is an appropriate 'tool box'.

gear override, for instance, is the # key on most UK keyboards and not the ` key as shown in the Instructor's Page key summary for the US variety. Owing to this variety of keyboard layouts, I have attempted a summary of mouse control techniques only in Appendix 2 to this document (see page 71). Once you're familiar with all that, and the keyboard mapping for your country, and can handle all the kinds of switches and knobs, and find all the relevant panels when you need to, you can actually (at long last) *start* to think about getting your 747 into the air! (But if you can't wait, then there's always page 12 for a quick and easy flight).

Flight Preparation: let's get on with it!

> (Note — there are numerous checklists available on the Internet and elsewhere — but notably, of course, the one which begins on page 275 of the PS1.3 manual. That is the checklist upon which the Tutorial is based, although the full Tutorial also covers some additional features, and goes into a *lot* of detail to assist those who are very new to PS1: this extra stuff will soon become tediously familiar so that you will then be able to switch to the more streamlined checklist. A summarised version (but still running to around 15 pages!) of the whole thing, for use when you become more familiar with the Tutorial, is given here as Appendix 7. Initially, though, the long list which follows also aims to hand-hold you throughout — hopefully saving you some frustration, even if it's only in terms of *finding* the items listed. If it seems pedantic, that could be because it's trying to get you used to good habits ☺).

Gathering pre-flight information

This section is simulator-specific, although it has obvious parallels in the real world. For example: in the real world you will, prior to going to the aircraft, receive from dispatch several bundles of printout — some detailing your route, obviously, but the majority concerned with weather forecasts and diversionary airfields along the way, not to mention the inevitable NOTAMS (NOTices To AirMen — should that now be NOTAPS for AirPersons?). With PS1, this information is obtained (or set, once you become more confident) on the Instructor's Page. At this point, I'll cover only the items which you need to look at when you are using an INI (Situation) file from someone else, resisting the temptation to add comments about setting them up yourself (perhaps in the version 5.0 Tutorial . . . ? ☺) — some additional stuff not *essential* for this Tutorial is, however, included as Appendix 13.

The Instructor's Page

We already know that our route today is from Glasgow (ICAO code EGPF) to Heathrow (EGLL). Since you will have enough to worry about anyway, I will minimise PS1's ATC (I will, however, be providing a certain amount of ATC input myself, as you will see): otherwise you would want to visit the Air Traffic Control page and ensure that your origin, destination, and cruise Flight Level were correctly set, and stipulate the options (and even accents [15]) in use. Similarly, you will not at this stage want to inflict any malfunctions on your aircraft, but you **will** want to visit these items (it's a good idea to provide yourself with a pen and paper at this point — you cannot trust your memory with all the important items you will need to note!):—

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[15] If you would like to hear an English accent on a British trip such as this, you can even download my own dulcet (?) ATC tones from the Aerowinx web site. (Try http://aerowinx.com/html/miscellaneous.html)

Preferences ('Program' column, on the right)

Ensure that the box "Always keep current configuration when loading situation files" is *un*checked. This means that when you load the GOWLHR13 situation file you will get the correct (BA) configuration so that all the items discussed in this Tutorial will be relevant. (Normally, people only check that box having explored many different configurations and finally settled on the one which they prefer to permanently retain). Verify that the "External data link on" box is *un*checked, too. **C**lick on the red "OK" button to move on.

Load ('Situation' column)

Use the red button >> to find GOWLHR13, and click (once) on it. Note that it immediately tells you that this is a BA configuration: do *not* have the "Keep current config" box checked, then click on OK (or you could have simply double-clicked on GOWLHR13 to accept it as-is). You are returned to the Instructor's Page.

Departure WXR ('Weather' column)

Write down anything which affects the possibility of Icing **C**onditions (less than 12° **C** with fog, rain, or cloud) for your departure. Normally, this information would be included in the fat bundle of printout you get from Dispatch, but in PS1 you have to assess the situation for yourself. **C**heck the altitude of the top of the clouds (regardless of whether rain is actually selected) so that you know whether to switch on anti-icing, and if so when to switch it off: even if the temperature at ground level (i.e. MSL) is shown as greater than 12° you still need to work backwards by a rule-of-thumb standard lapse rate of -2° per 1000 feet right up to the top of *all* the cloud layers before you can decide whether or not you need to turn the TAI on. (Obviously this and the following two items will change if the Situation changes, so make sure you have loaded GOWLHR13 before checking these figures).

Cruise WXR 3 ('Weather' column)

Make a note of the winds at FL 350: if the entry is, for example, 081/35/35 ☺ this indicates that the winds at 35,000 ft are from 081° at 35 kts with no gusts. You will need this information whilst in the cruise to assist the FM**C** to compute your descent profile more accurately. Although you will also need the winds at ground level at your destination, you can get that information from ATIS: *this* information, however, would normally also be included in that wad of paperwork from despatch, so make a note of it now ready for later on. For a long flight, you should get the wind information for WXR 1 and 2, as well.

Arrival WXR ('Weather' column)

As with the Departure icing information, the same goes here for anything which affects the possibility of Icing **C**onditions for your arrival. Once again, work backwards from the MSL temperature (by -2° per 1000 feet) right up to the top of the highest cloud so that you know whether and when you need to turn your anti-icing on for the descent. Today you might

also notice that scattered Thunderstorms are also indicated (see the bottom right hand corner of the WXR page) . . . .

Preflight Items ('Airplane' column)

These are quite important just now, obviously: let's walk though them one at a time.

- Write down the "**C**enter of Gravity" figure — you will need this, later.

- Also note the Zero Fuel Weight (ZFW), and Fuel Quantity (these will be in Kgs, for a BA configuration — see Appendix 14 for details of how these were derived).

- Note that your fuel today will be Jet-A (Scotland's climate is being kind to us ☺)

- Ensure that the Hydraulic Fluid Quantity and Auxiliary Power Unit Oil Quantity figures are better than 95% (if not, *this is where you top them up!*).

- Ensure the "External power and bleed air available" box is **un**checked (we'll use the APU, today).

- Normally, if you're feeling brave, you *could* check the "Meet unprepared cockpit (random switch positions)" box, although perhaps it might be best if you don't do it the first time or two whilst you're following this Tutorial — then we're guaranteed to be in sync. But there again — I *always* check it ☺.

- **C**lick on OK: if you *were* brave, then an info box tells you that Hardy has flipped a few switches — click anywhere to dismiss it and return to the Instructor's Page.

Airport Info ('Analysis' column)

Click on "New" (**IC**AO code) and enter EGPF (or EGLL) and press Return. Here you need to make a note of the relevant comms frequencies which you may need — anything (or when you are following other routes probably *everything*) from the ATIS of your departure airport right the way through to the ILS frequencies of your destination airport. Even if you have some of this information on the charts you intend to use, *double-check it here* — because these are the frequencies that *PS1* will use, regardless of what your chart says. For example: in the Tutorial we shall be landing on Heathrow's 09L runway. The ILS chart for 09L in Appendix 14 gives us the localizer on 093°, but when we check in Airport Info we find that PS1's localizer is on 094° — so *that* is the value which we will need to use!

That will probably do, for now, so press Escape to transport yourself onto the flight deck (you may need your torch, it's a bit dark at the moment . . . .)

One final comment: my own self-imposed rule is that returning to the Instructor's Page at any point after you've started is definitely cheating, so I always make sure that I've visited everything I need there before setting off. But you can make your own rules, of course ☺ .

Now we're on the flight deck, take a moment to notice the standby instrument display (top left, over the outside view — this is what appears if you should ever have the misfortune to lose electrical power) — and also (unless you have a laptop or any other machine with an

"embedded" numeric keypad) to toggle the NumLock key to remove any message telling you that it is off.

OK, here we go!

Just one friendly warning:—

The checks in Section 1 (below) are vital. If you miss a single one of them you *might* be lucky in that it doesn't matter because the switch just happened to have been left in the correct position. However, because *none of these checks are optional* it is likely that you will subsequently encounter difficulties sooner or later — perhaps *much* later, when you are in the air. The majority of the more mysterious questions asked on the Aerowinx forum can be explained by an absence of care at this stage: don't let it happen to you!

I included the checklist in Appendix 7 mainly because of requests for a version of the checklist in the manual which can be printed out and scribbled on — so, especially while you're still unfamiliar with this stuff, I suggest that you *literally* tick each item off immediately **after** you have done it. If you look at the video and see the speed with which the checks can be performed when they become familiar to you, you will also realise that (while you are also struggling to appreciate the logic behind them) taking them slowly could, paradoxically, cause you to unknowingly miss just one vital item — with catastrophic effects later. And since later it is usually quite difficult to track back and discover the item you missed (as those desperate calls for help on the Aerowinx forum amply demonstrate) make your priority to be doing the checks *thoroughly*, and let the speed come naturally — it will, in time ☺ .

OK, enough preparation, it's time to get into the cockpit and start your trip! Press Escape if you're still on the Instructor's Page, and off we go . . . . .

SECTION 1: Waking your 747-400 from its sleep

Go to the *ELECTRICAL panel* (i.e. click on the ND display and choose the bottom ELEC button):—

- **Press** the BATTERY switch (“ON” should appear and any amber ‘OFF’ indication should disappear).

- **Turn** (right-click) the STANDBY power selector to AUTO (the flight deck panels will light up and numerous amber caution messages will appear in the activated upper EICAS).

Go to the *HYDRAULICS* panel (move your mouse right) and:—

- Check that all four hydraulic demand pump selectors (rotary switches) are OFF.

Go to the *MISC panel* (“centre panel clipping”) —

- Check that the ALTN FLAPS selector rotary switch (top right) is at ‘OFF’.

Check the landing gear lever (just below the bottom centre of the ND) is at the DowN position.

Also, check that the flap lever agrees with the flap indicator on the upper EICAS: they *should* both be indicating flaps up (unless the previous crew were in a dreadful hurry for some reason). The flaps up indication on the upper EICAS is that either the flaps indicator is not present at all, or, if it *is* present, a green ‘UP’ is shown at the top of the vertical scale.

Go to the *ELECTRICAL* panel (move your mouse left, or click on ELEC at the bottom):—

- Check that all four BUS TIE switches (the row in the middle of the panel) are showing ‘AUTO’, with no ‘ISLN’ captions.

Until the engines are started we will need additional electrical power for the aircraft systems, either from outside the aircraft or else from the Auxiliary Power Unit in the tail. For this Glasgow to London example, we will use the APU rather than external power. (External power is used where possible if you want to conserve all the fuel you can for long haul flights, since the APU will obviously be consuming the precious stuff whilst you continue with the checks). Once you have more experience you may prefer to use external power at this stage, so I will include a section later to enable you to switch over to the APU prior to take-off (the cables don’t stretch very far . . . . ☺).

(Still on the *ELECTRICAL panel*) —

- ROTATE the APU selector through ON to START, and let it spring back to ON.

(You can watch the STAT synoptic’s APU EGT figures if you want to see the Exhaust Gas Temperature rising. When the APU turbines are spooled up and ready to provide electrical power and bleed air there will also be a message in white letters on the upper EICAS saying

'APU RUNNING', but unless you use the CANCel button to clear the amber cautions, you may not notice it).

- Once the APU is running, check that the 'AVAIL' lights are lit.
- Click on the APU GEN 1 switch to switch it on (and *wait* for a few seconds).
- Verify that the ON light illuminates and the AVAIL light goes out.
- Action the other APU button also (after a pause), and check as above.

We now turn to the IRS (Inertial Reference System), which we will assume requires a full alignment [17]. Had the aircraft just flown in to Glasgow half an hour ago then we could consider doing a quick alignment, but since it has been fully shut down and left overnight, we'll definitely invest the ten minutes required for a full alignment — we've plenty to be getting on with, in the meantime.

Go to the *EEC+IRS panel* —

- Ensure all four ELEC ENG CONTROL switches are set to NORM.
- Move each of the L, C, and R (Left, Centre, Right — you guessed) switches to OFF (two clicks, if they're currently pointing to NAV) and back again to NAV (one click).

We will also be entering our position in the FMC's POS INIT page shortly.

Go to the *FIRE panel* —

Push **and hold** the Fire/eng APU cargo test switch (top left-hand corner) until the PASS message appears. If you watch the upper EICAS you will see the red "TEST IN PROG" message, and ultimately "FIRE TEST PASS" once the process is complete — *now* you can stop pressing the test switch.

Go to the *MISC panel* —

- Check the EMER LIGHTS switch is at 'ARMED' (centre position)
- Check the 'FUEL XFER MAIN 1+4' switch is OFF (i.e. no ON caption is showing)

Go back to the *FIRE panel* —

A few words of caution and explanation may be helpful, here. You will recall the operation of the fire handles from the 1.3 manual (page 13, if you need a quick revision). To operate them, they must first be *pulled* (a click in the simulator results in the pulled handle looking slightly larger) and *then turned* left or right. Since our first check is that all the handles are **in** (and not rotated or illuminated) it is easy to fall into the trap of just checking that they are *all the same size* — but this could equally well mean that they are all pulled out! If in doubt, click on one: if it gets bigger then it was in already, and was OK, so click again to push it back. If it gets smaller, then it was out — how about the others?

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[17] The full version of the checklist (Appendix 7) also covers how to do a quick alignment. **Important note for those using 1.3 without the 1.3a upgrade**: if you are *very* new to all this and are not confident of reaching the entering of your position in the boxes (on page 29) within the ten minutes which the IRS needs to align, then go and do the FMC phase 1 stuff starting on page 28 and up to where there is "SOME NON-FMC WORK TO DO" — *now*, before you do anything else, and then come back to this point and simply omit what you've already done when you come to those pages again. You can be fairly sure that it won't take you ten minutes to cover the next four pages once you have been through this once or twice, though.

- **C**heck that all four engine handles and the APU handle are in, not rotated or illuminated.

We now need to check the discharge lights — the line of eight (hopefully not illuminated) lights below the four handles (two bottles per handle, each fired by turning the associated handle left or right) and also the (hopefully) dark light immediately below them and near the centre.

- **C**heck that the nine discharge lights are not illuminated.

Go to the *ENGINE START+FUEL panel —*

On the Engine Start section:—

- **C**heck that the START knobs (the four grey knobs top left labelled 1, 2, 3, and 4) are pushed in (i.e. not illuminated white).

Now work from left to right along the row underneath —

- Verify that the standby (STBY) ignition rotary switch is at NORM.

- Verify that the IGNITION **C**ON (**C**ontinuous Ignition) is OFF (i.e. no "ON" legend is visible on the switch).

- Verify that the AUTO ignition rotary switch is at NORM (or as appropriate).

- **SET** the AUTOSTART button (just to the right of the above item) "ON" (if it isn't already) [18].

On the Fuel Jettison section:—

- Verify that the FUEL JETTISON control (rotary switch) points to OFF.

- Verify that both L-NOZZLE-R (nozzle valve switches, in the red boxes) are OFF (no "ON" legend visible).

- Verify that no amber VALVE lights are lit (in the jettison nozzle valve switches)

On the Fuel section:—

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[18] Since this is a BA configuration, there *will* be an Autostart switch present — if there isn't, you need to change configurations or start the engines manually. Of course, PS1 happily supports you if you want to start the engines *without* using autostart – see Mel Ott's description on page 337 of the PS 1.3 manual — remember that you must start the engines **one at a time** when using this procedure (not in pairs), and that any Autostart switch must be OFF (if fitted).

- Verify the FUEL PUMP switches (8 Main and 4 Override) are all OFF (“ON” not visible).

- Verify all 8 Main Pump PRESSure lights are illuminated if you are on *external* power: if the APU is running, though, the MAIN AFT 2 and 3 PRESS lights will *not* be lit [19] because those pumps are currently supplying the APU with fuel — although the other six PRESS lights should be.

- Verify that the left and right centre pump pressure lights (in the middle) are OFF.

- Verify that the left and right stabiliser pump pressure lights (immediately below them) are OFF.

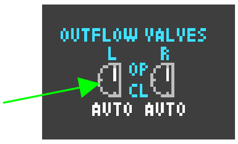
- Verify that the forward and aft override 2 pump pressure lights (between Main 1 and 2) are OFF.

- Verify that the forward and aft override 3 pump pressure lights (between Main 3 and 4) are OFF.

Go to the *Glareshield panel* and mouse along to the right hand side —

- Select the ECS synoptic display switch

- Locate the OUTFLOW VALVES at the top right hand corner of the lower EICAS display and check that they are OPEN (the packs are off and the cabin is not pressurised yet) — i.e. the needles are pointing up to OPen, and not down to CLosed).



Go to the *MISC panel*, “overhead panel clipping” —

- Verify that the TRIM AIR is ON.

- Verify that both the recirculation fan switches (UPR-RECIRC-LWR) are also ON.

Go left to the *PNEUMATICS panel* —

- Verify that the EQUIP COOLING rotary switch is at NORM.

- Verify that the HI FLOW switch is OFF (i.e. no “ON” legend visible).

On the Bleed Air sub-panel —

- Verify that the Packs’ Reset Switch’s (PACK RST’s) SYS FAULT light is off (top centre).

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[19] In some configs it may be only the MAIN AFT 2 PUMP light which is unlit since these use an electrical Scavenge Pump — this has been replaced in the BA and other configs by a different fuel system. (I originally thought it was to do with the Hydromechanical Jet Pump, but Hardy clarified the matter: “The Hydromechanical Jet Pump in the Center Wing Tank is a just a part of the new fuel system. ‘Hydromechanical’ means free of electrics with less risk of a fuel tank fire — the TWA 747 accident. Another feature of this new fuel system is the symmetrical fuel distribution to the APU from Main Tank 2 and 3 (which has nothing to do with Hydromechanical Jet Pump in the Center Wing Tank). The APU pumps are still electrical)”.

- SET the PACK control selectors 1, 2, and 3 to NORM (i.e. ON — white EICAS messages will confirm the current configuration).

- Verify that the L ISLN and R ISLN isolation valve switches are both OPEN [20] (i.e. ON — a white bar should be visible in both, connecting with the horizontal white bar on the panel).

- Verify that the ENGINE BLEED air switches 1, 2, 3, and 4 (bottom row) are all displaying "ON".

- Verify that the four Engine bleed SYS FAULT lights above the engine bleed switches are *not* illuminated.

- Verify that the APU bleed air switch is "ON".

- Verify that the L ISLN and R ISLN switches have their "VALVE" lights off, and the white bar showing. You can check the Duct Pressure on both the upper and lower (ECS) EICAS displays

Go to the *Glareshield panel* and mouse along to the right hand side —

- Select the STATus synoptic display switch

Time now to turn to the FMC . . . .

PHASE 1 OF THE FMC WORK

Remember — if you are going to input anything you must first press <shift> to get into FMC input entry mode, and you will then need to use the numeric keypad for all numbers — except for pressing 1 - 6 (above the qwerty keys) for the left column of Line Select Keys (F1 to F6 for the right hand column). If you have a laptop I find that it is usually easiest to leave the keyboard in normal mode for most of the time, and toggle the embedded numeric keypad feature only as and when you need it — or, better still, use the number keys on the large CDU by clicking on them with the mouse.

When you need the CDU buttons (INIT REF, MENU, etc.) and not just the Line Select Keys, click on the FMC screen which is always present just to the left of centre at the bottom of your monitor (or press Tab). The large version now opens, and it has some buttons which we will need now.

- Go to the CDU and click on the INIT REF button (top left, just under the screen — or you could just use <F7>) to reach the POS INIT page (1 of 2). If for some reason you don't get there, hit INDEX <6> then POS <2> (only if you need to — it shouldn't be necessary at this stage).

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[20] Hardy points out that the terminology here could possibly lead to confusion: although pneumatic, fuel, and hydraulic valves are either 'open' (allowing flow) or 'closed' (and not 'on' or 'off' as you will find in some checklists) in the case of electrical devices the meaning is reversed — the elec SSB 'open' (continued overleaf) (continued from footnote on previous page) means SSB '*cutoff*'. For these reasons he would have preferred Boeing to have used terms such as 'cutoff' and 'run' which would eliminate the contradiction.

- Select < INDEX (Line Select Key six left — LSK 6L — see the introduction to Appendix 7 for an explanation of the identification of LSKs if you're not sure). The shortcut key is the "ordinary" (non-numeric keypad) '6' above the T and Y keys (on a UK/US keyboard, at least).

- Select the IDENT page (LSK 1L)

- Check the details on the page. In this British Airways configuration, Rolls Royce RB-211 engines are fitted, and this fact is reflected in the FMC programming which is confirmed here.

- Select the POS INIT page (LSK 6R)

Since a full IRS alignment is in progress, we need to sanity check our last position as shown top right. If this is reasonable for Glasgow (we are in Glasgow, aren't we? What day is it? Oh yes . . .) then (after removing any "ENTER IRS POSITION" message with Backspace):—

- Copy that last position to the scratchpad by pressing LSK 1R

- Copy the scratchpad entry to the SET IRS POS boxes by pressing LSK 4R [21].

- Check that the GMT (a.k.a. UTC a.k.a. ZULU) time adjacent to LSK 5L agrees with the clock at the lower left of your monitor.

- Select the ROUTE> key (LSK 6R) to bring up the RTE 1 page.

- Type our flight number SP1313 into the scratchpad (numeric keypad for numbers, remember), and press LSK 2R to enter it.

- Dismiss the large CDU by clicking on it or pressing the Tab key.

If you are using 1.3a (or if you are using 1.3 and have completed your IRS Full Alignment or are doing a Quick Alignment) you can now:

- Set the Autobrakes to the RTO (Reject Take-Off) position [22].

OK, we can leave the FMC alone for a few moments whilst we check some other important stuff (phase 2 of the FMC work starts in about a page or so ☺).

SOME NON-FMC WORK TO DO

Let's look at the Ground Proximity panel:—

- Verify that the Ground Proximity light is not illuminated in the G/S INHIBIT switch, just to the right of the gear and flaps selectors.

---

[21] If the boxes are no longer there and you haven't upgraded to 1.3a, then you've taken too long over the last four pages! You must, in that version of PS1, have entered the position before the IRS alignment is complete, or else the boxes will disappear. See the footnote on page 25, then reload the Situation and start again.

[22] (If you hadn't completed your Full Alignment, then a quirk in the release version of 1.3 — i.e. not 1.3a — meant that you shouldn't be setting the autobrakes yet — so I'll remind you to set them later ☺).

- Just to the right of that, verify that the Ground Proximity / Flap Override switch (FLAP OVRD) is OFF (i.e. no OVRD legend is showing in the upper half of the switch).

- Right again, and verify that the Ground Proximity / Gear Override switch (CONFIG GR OVRD just above the Comms frequency windows) is OFF (i.e. no OVRD legend is showing in the upper half of that switch, either).

Go to the *MISC panel* "centre panel clipping"—

- Verify that the ARM switch for Altn Flaps (below the rotary switch you checked before) is not pressed [23] (i.e. "ALTN" is *not* visible in the upper half of the switch).

- Verify that the gear override switches (ALTN GEAR EXTEND NOSE-BODY and ALTN GEAR EXTEND WING) are both OFF (no "ALTN" legend visible in either of them).

The lower EICAS will have the STATus display (you set it just before doing the FMC stuff, remember?).

- Check the lower EICAS display to see if the HYDRAULIC quantities 1 - 4 ("HYD QTY" — second line of figures in the display) are in white.

If the magenta letters 'RF' ('ReFill') are displayed by the figures, this means that you should have topped up the Hydraulics in PreFlight items on the Instructor's Page, setting the quantity to somewhere between 95 and 100%.

- Also check to ensure that both crew and passenger oxygen pressure are OK (>=1600 p.s.i.).

- Check any status messages [24] which might be present in the lower EICAS, actioning them appropriately.

THE ROUTE

At this point you would normally dig out of your bag the route given to you by Dispatch. In this case, *I* will be giving you the route — but if you're interested in the how and why (and soon you will want to be, when you start planning routes of your own), I've included some details in Appendix 14 so as not to clutter things up at this point. I have included the relevant charts for our trip in that Appendix, too, so that you can view them when you want to without interrupting the flow too much at this point. [25]

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[23] When I asked about the construction of these switches, Hardy replied that the indication in the **upper** half of these black switches is a **mechanical** shutter which is moved when the switch is moved (covering the word OFF, ON or ALT etc.) and is, therefore, visible/invisible independently of electrical power. The **lower** half, however, is just an **electrical** light (PRESS, VALVE etc.), i.e. that indication is only functioning if power is on and the light is working.

[24] Status messages appear on the lower EICAS in the STAT synoptic view (Hardy adds that in KLM configs they also appear in the ENG view).

[25] If you're not sure how to interpret these charts, some illustrative examples are given in Appendix 15.

PHASE 2 OF THE FMC WORK

First we need to enter our start and end points:—

Click on the FMC screen which is always present just to the left of centre at the bottom of your monitor (or press Tab) to open the large CDU, and press the RTE button. Press a shift key if necessary to light up the buttons in yellow (input mode) — don't forget to type all the numbers on the numeric keypad whilst you're entering data in this mode. Using 1 – 6 above the alpha keys for the left LSKs doesn't count as entering data!

- Enter EGPF in the scratchpad (i.e. type EGPF when the buttons are lit up) and click LSK 1L with the mouse or press <1> to transfer your typed ICAO code into the FMC as our point of origin.

Before even thinking about the Departure we're going to use we have to first of all discover the departure runway in use. . You noted down the ATIS frequency for Glasgow before entering the flight deck, didn't you? (if not, you will have to press Escape to get to the Instructor's page and find it now — but that is not the preferred way to do it ☺).

Click on the standby communications frequency figures below the Config Ground Override switch until you have selected the ATIS frequency (132.17, for Glasgow) and then click once on the active value to swap the value you just entered in the standby box into the active frequency. You'll receive the Automated Information, so note it down and then click again on the current value to swap back to the original frequency and silence ATIS. The weather outside doesn't seem too nice . . . . . notice in particular that a temperature of less than 12°, combined with rain, constitutes *icing conditions*.

This is all useful information — not just the runway in use, but also such items as the barometric pressure at Glasgow, the Outside Air Temperature, and the transition altitude.

- Enter the barometric pressure (current QNH) by clicking to the right of the STD knob on the EFIS control panel (to the left of the glareshield) until the pressure as given by ATIS is shown at the bottom right of the PFD. (You may first have to click to the *left* of the knob to set whether this has been given to you in Inches of mercury or millibars / hectoPascals — since this is BA we will use 1014 mb / hPa).

- Enter the destination airport ICAO code (EGLL in this example) into the scratchpad, and transfer it into the DEST line by pressing <F1>, or click the top Line Select Key on the right hand side.

- Enter 05 for our departure runway by typing 05 in the scratchpad (not forgetting to use the numeric keypad (with Num Lock engaged) for the "05") and press <3> (a dotted white line depicting the runway orientation will then appear on the Navigation Display).

- If you had a Company Route available you would enter it here using LSK 2L. Since you haven't (I deliberately haven't provided you with one to make you go through all the procedures), continue below.

We now start to enter our route, which is (to recapitulate from Appendix 14):—

"From Glasgow rwy 05, follow the New Galloway One Juliet SID to NGY, then go direct to Deans Cross (DCS). Join airway UA1 and follow it all the way to Honiley (HON), at which point we join the Bovingdon 1A STAR which routes us through to the hold at Bovingdon (BNN). Once released from the hold, we follow the Approach for ILS 09L, taking us past Windsor castle and on to the runway.”

(The relevant charts are all included in Appendix 14, and I’ll be referring to them from time to time as we progress: the chart for our SID — Standard Instrument Departure — is on page 157).

So let’s enter most of that route information into the FM**C**, omitting only the STAR. First of all, we’ll nominate the correct SID (N.B. if you haven’t copied the supplied Glasgow SIDs into the \DEPARR\Egpf folder then this isn’t going to work).

- Press the DEP/ARR button on the FM**C**.

- Press <1> (LSK 1L) to view the departures for Glasgow.

- Since you have already nominated runway 05 on your route page, you will see 05 already <SEL>ected on the right, and the applicable SIDs for that runway listed on the left. (If not, then — using the LSK — select rwy 05 so that you can see the list of associated SID’s in alphabetic order — probably extending over several pages, in the case of major airports).

- (Using the Next Page button if necessary) select the NGY1J departure (a “<SEL>” banner will appear next to it, and as much of it as will be visible within your selected ND range will be displayed on the ND as a dashed blue line (if the IRSs have aligned).

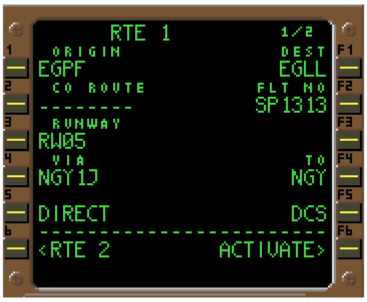
Although we *could* also take an educated guess and enter our STAR now, we’ll defer this until it has been confirmed once we’re in the cruise. On longer trips there could be many factors which would make guessing the STAR to be used in many hours’ time an extremely chancy business, and so this activity would normally be deferred, anyway.

- Press the RTE button. You will find that the FM**C** is now recording the fact that the first stage of our route, after leaving rwy 05 at Glasgow, will be the NGY1J departure to NGY (New Galloway).

You will recall that from NGY we hop across to Deans **C**ross to join the airway, so we’ll now enter that information into the FM**C**.

- Type D**C**S into the scratchpad, and press <F5> (or use LSK 5R). You will find that the word “DIRE**C**T” appears at LSK 5L, and the screen now looks something like the one shown (right).

- Obviously, there’s no room for any further information on this screen, so press the NEXT PAGE button to give yourself room for more typing.



```
         RTE 1              1/2
 ORIGIN                    DEST
EGPF                       EGLL
 CO ROUTE                FLT NO
---------               SP1313
 RUNWAY
RW05
 VIA                         TO
NGY1J                       NGY

DIRECT                      DCS
-------------------------------
<RTE 2                ACTIVATE>
```

Since we’ve reached the airway, we can simply indicate that we want to follow it all the way to Honiley. The airways database will then be able to fill in the waypoints (which we will view on the LEGS screen in a little while).

- Enter UA1 into the top VIA column (LSK 1L) — you did remember to use the numeric keypad for the '1', didn't you? — and note that boxes now appear by LSK 1R indicating that input is required. (The FMC is asking where we want to get off the airway).

- Enter HON and press LSK 1R. (Honiley is the start of our most probable STAR into Heathrow).

- Finally, enter a bare EGLL and press LSK 2R: in Hardy's words "This improves fuel/ETA predictions. The later entry of a STAR or selection of an Approach will automatically delete this last 'EGLL' waypoint ."

That's all we need to do for now — the FMC already knows that we're ultimately heading for Heathrow, so it can work out a few things for us on a preliminary basis. Before leaving this page, though, we want to confirm that we weren't just playing "what-if" games: this really is the route we want to follow. Note that at present the top of the CDU page says simply "RTE 1".

- Press LSK 6R to ACTIVATE the route. (Note that the EXEC button lights up, awaiting confirmation that you want to Execute this decision).

- Press the EXEC button. The light goes out and two other changes take place on the screen — the top of the screen now says **ACT** RTE 1, showing you that this is the Active route; also you may notice that the dashed blue line on the ND now becomes a solid magenta one as an indication of its Active status. If the message UNABLE NEXT ALT appears, simply press the CLR button (or Backspace key) to get rid of it — we'll worry about the up and down aspects of our flight a little later.

Let's pause for a moment at this point to review what you've done so far. You have told the FMC where you're starting from and where you're going; and you have nominated the route to get you there — leaving just the exact manner of your arrival until you can be sure that ATC won't change your mind for you ☺. But you haven't (as yet) entered any fuel-sensitive information such as how far and how fast you want to climb.

You may not have noticed, but several things have happened as a result of what you've entered. As mentioned above, your route — at least the beginning of it — is probably now visible on the Navigation Display. But the departure information has now been entered into the LEGS pages for you, too.

Press the LEGS button (<8>) on the CDU. You will see that the waypoints for your selected departure and cross-country routeings are now entered. Using Next Page (<PgDn>) you can follow them through, and you'll find that nearly three pages of waypoints have been entered for you. But there's one additional task which is needed.

It's always highly recommended to check the route through visually to make sure that it looks sensible and has no discontinuities. So set the ND mode selector on the left of the glareshield to PLN and the range to, say, 40 nm — North is up on the screen now, by the way — and use the STEP> LSK (<F6>) on the LEGS page to step right through the plan, watching the ND display to make sure that you don't have any unexpected deviations or discontinuities [26]. Our route stops rather abruptly at EGLL but that's OK, we'll definitely be entering the STAR information before we get there! Return the ND mode selector to MAP and set the scale to 10 nm once you're happy that your route is correct.

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[26] A discontinuity (DISCO, for short) is the FMC's way of asking us whether we really do want to proceed from (say) NGY direct to DCS, and our way of confirming our intention is equally simple:

OK, just a bit more FMC work before we return to the checklist. You may recall from Appendix 14 that I used FuelPlan to calculate the figures needed here, so:—

- Press the INIT REF button on the CDU to get to the PERF INIT page.

- Enter 4.0 into the scratchpad and transfer it into the RESERVES line using LSK 4L. (Disregard and discard, using the BackSpace key, any INSUFFICIENT FUEL messages which may appear — it's just the FMC worrying, but then we haven't yet told it how high we'll be flying).

- Enter 60 and transfer this into the COST INDEX (LSK 5L).

- Enter 290 and transfer this into the CRZ ALT line using LSK 1R. Notice that the FMC correctly assumes that we are requesting Flight Level 290, not 290 feet ☺.

- Press the NAV RAD button on the CDU.

- Confirm that the VOR beacons (top left and right) are reasonable for our present position.

- Check any other frequencies (we don't yet know which runway we'll be landing on at Heathrow, so the ILS frequency will not be present, and 'PARK' will be displayed [27]).

Go to the *EFIS control panel* (left of glareshield — move the mouse left onto it if the panel isn't currently visible)

- Set the two toggle switches on the panel *up*, i.e. to L VOR and R VOR, respectively. Check that these VORs are shown at the bottom left and right hand corners of the Navigation Display.

That's enough FMC stuff for the moment — you've provided information about *where* you're going. Later, in phase 3 of the FMC work, you need to refine that by sorting out how fast you're going to climb in the process, and hence how much fuel you're going to use (and sort out any UNABLE NEXT ALT or UNABLE CRZ ALT messages): for now, though, it's back to the checklist!

- Click on the large CDU to dismiss it

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press the adjacent LSK to copy the correct next waypoint *after* the boxes into the scratchpad, then press the LSK *next to* the boxes to copy it back into the discontinuity (i.e. where the boxes used to be), then press EXEC to confirm your action. Follow this same approach to heal any other discontinuities (unless, of course, you notice a distance of several thousand miles between the entries, in which case you have fairly obviously picked the wrong waypoint and need to correct it).

[27] Note that should you ever need to enter a frequency here manually, it will be followed by a small "M" denoting manual tuning status: however, we want the FMC to autotune the VOR's for us during the trip, so you would need to press the DELete key and <1> to revert from the manual "M" back to the default "A" indicating Autotuning. (A "P" would have indicated Procedure Tuning, in other words as required by the current IFR departure or approach procedure; whereas "R" would indicate Route Tuning, i.e. chosen because it's the next VOR on the flight plan within 250 nm of the aircraft or its projected route).

Go to the *ELECTRICAL panel*

- **C**heck/set the L-UTILITY-R utility power switches (top centre) both ON
- **C**heck/set the GEN **C**ONT switches 1, 2, 3, and 4 all ON in white (amber OFF lights will also be present, which is normal at this stage).

Go to the *HYDRAULICS panel*

- **C**heck/set the four hydraulic engine pump switches (on the bottom row — *not* the rotary DEMAND switches) to ON (amber PRESS lights will also be lit at present).
- **C**heck that all four SYS FAULT lights (top row) are lit
- **C**heck that all four pump PRESSure fault lights (second row) are lit

Go to the *MISCELLANEOUS panel*

- Set the NAVigation Lights to ON
- Set the four nacelle anti-ice switches to AUTO (centre position, in this airline config) [28]
- **C**heck all landing lights are currently OFF

(In the event that this was going to be a low visibility take-off, the PVD would be checked here — see the full checklist in Appendix 7 for details).

Go to the *EFIS control panel* (left of glareshield)

- Remove any DH (Decision Height) display from the PFD (by setting it to below 0 feet). To do this, left click to the left of the RST button on the left-most panel of the glareshield so that the knob points to DH (decision height), then left click to the right of the RST button until you have reduced the DH to below zero feet and the DH indication disappears from the PFD.
- Remove any MDA (Minimum Descent Altitude) display from the PFD (by setting it to below -1000 ft). To do this, left-click by the MDA button so that the knob points to MDA, then remove that indication too (you have to get it below *minus* 1000 ft).
- (Also check that a Radio Altitude figure is displayed (in white, above the top right hand corner of the representation of the artificial horizon — just below where the Decision Height display was, if it was present). It should be reading between –6 and –10 ft since it is calibrated to read zero just as the first tyre pairs touch down on landing, at which point the radalt antenna (which is well forward of the main gear) is around 8 ft higher owing to the slightly nose up attitude of the aircraft at that time than it is at present with the pitch normal and the aircraft parked).

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[28] In general, your actions with regard to this item will depend on the possibility of Icing during your Departure (see Pre-flight Items, above). If icing is definitely indicated, you will probably want to change this setting to ON, later, as we will see.

Go to the *AFDS Mode Control Panel* (to the right of the EFIS control panel)

- Set the left Flight Director switch to ON (notice the green annunciators which appear on the PFD. The surrounding green boxes indicate a change in status and will soon disappear).

- Set the Autothrottle ARM switch to OFF

- Set the bank limit selector to AUTO

- Set the heading selector to the runway heading as noted from your chart or the airport info in the Instructor's Page — in this case it's 052° (but you knew that, didn't you?). Hopefully, the dashed magenta line on the ND which appears as you move the selector is now parallel to the runway, or even coincident with it if you are close enough or the range setting is high.

- Set the altitude selector to our first altitude constraint of 6,000 ft (when you are not following this Tutorial and have no SID then you could set it to your cruise altitude straight away). As you cross the waypoints you can then reset the altitude for the next constraint, and so on until you reach cruising altitude). The altitude set here is also reflected on the PFD, this time in magenta near the top right hand corner.

- Toggle the Autopilot disengage bar to ensure that it's UP (no yellow bar visible)

Go to the Speedbrake lever (just under the TOGA button, although in the aircraft it is to be found on the *Control stand)*

- Check / Set the Speedbrake lever to DN (down)

Moving left from the speedbrake lever and down to the bottom of the screen:—

- Set the parking brake: the upper EICAS message confirms its status, although you may have to use the CANCel button (on the right of the glareshield) to remove all the amber caution messages in order to be able to see it. In view of this it is also useful, although it needs practice in the simulator, to be able to recognise the brake's status by the appearance of the lever).

- Ensure that the throttles are CLOSED and the reverse thrust levers are DOWN (in the absence of any throttles attached to your computer, check any indications on the upper EICAS).

Go to the *FIRE panel* (Control Stand clipping)

- Check that the four fuel control switches are all at CUTOFF [29]

(Below PFD centre)

- In the stabilizer trim indicator (to the right of the clock), ensure that the orange and grey OFF flag is NOT in view

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[29] Those from the UK will have gathered by now that aircraft switches work in the opposite sense to the UK domestic standard, with switch down meaning OFF.

Comms frequencies

At this point you need to set the Radio tuning panel to the Ground frequency (or Tower, if Ground doesn't exist). So use the technique you used before when listening to ATIS to set Glasgow's ground frequency of 121.70 in the Active (left) comms window.

PFD indications

Check the following on the Primary Flight Display:—

- The amber "NO V SPD" flag is displayed top left (as it should be, until the V-speeds are set)
- The Autothrottle annunciator (the left-most of the three at the top of the PFD) is blank
- The Roll mode annunciator (centre) has "TO/GA" displayed
- The Pitch mode annunciator (right) also has "TO/GA" displayed
- The AFDS status annunciator (below, and centre) shows "FD"
- The Heading Reference (in green, on the compass at the bottom) says "MAG"
- The Altimeter displays the airport elevation (26 ft, for Glasgow).

ND indications

Now check the Navigation Display:—

- Verify that no amber flags displayed
- Verify that this also displays MAG (top centre, right of the heading)

PHASE 3 OF THE FMC WORK

Select the large **C**DU

- Press the INIT REF button
- Select INDEX (LSK 6L)
- Select the POS page (LSK 2L) to go to POS REF 1/2
- Press the NEXT PAGE button to go to POS REF 2/2
- **C**heck the FM**C** position & ground speed against the L, **C**, and R IRSs
- Press the RTE key (LSK 6R) to go to RTE page

- Check that the correct runway is set for take-off
- Dismiss the large CDU

Go to the right hand side of the *Glareshield* panel

- Select the STAT synoptic display switch (if not already selected)

Check that no lower EICAS Status messages are displayed [30]

- Select the FUEL synoptic display switch and check the quantities in the tanks, and the total.

Go to the *ENGINE START AND FUEL* panel [31]

- Set the main FUEL PUMPS 1, 2, 3, 4 (both FWD and AFT) to ON (the PRESS lights should extinguish)

IF main tank quantity 2 > 1 and 3 > 4 do the following indented line:—
    Set all four crossfeed switches to ON (valves OPEN — white bar visible)

OR, if main tank quantity 2 <= 1 (or main tank qty 3 <= 4) do the following 3 indented lines instead:
    Set fuel crossfeed switches 1 and 4 to OFF (valves CLOSED — white bar not visible)
    Set fuel crossfeed switches 2 and 3 to ON (valves OPEN — white bar visible)
    Set override pump switches 2 and 3 to OFF (FWD and AFT: no ON legend visible)

PS 1.3 without the 1.3a upgrade AND a full IRS alignment has been performed	PS 1.3a OR PS 1.3 if a quick alignment was done
Set autobrakes to RTO if not already done (PS1.3-specific).	(RTO already set). No action required.

Checklists — some general notes

The checklist you get will depend on the configuration you are using (the ones in the PS 1.3 manual and in Appendix 7 of this manual are the ones for Lufthansa, so they are inapplicable in this case [32], as well as sometimes having different names). I don't need to reproduce all of the BA checklist items here, though, (other than the first one, as an example) since your trusty F/O will read them to you. "But how?", I hear you asking ☺ — it's simple.

To get the F/O to *read* you the checklist, be sure not to be in FMC input mode (!) and then keep typing 'R' (watching the bottom of the outside view window) until you get to the Cockpit Safety Checklist. You don't need to press 'R' again, since you now get the lists in order. Now press 'V' and you will see/hear the F/O read you each item in turn — confirm

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[30] These will be lower left, if present. If any *are* displayed, check the Minimum Equipment List (M.E.L.) to see whether dispatch is allowed with that status.

[31] Appendix 4 has a summary of fuel management techniques for a longer flight.

[32] This also introduces one or two small variations into the checklist itself, as you may notice.

OK by pressing ‘V’ again to hear the next item, and continue doing so until you see/hear “Flap position indicator and lever” [33]. (This use of the V key works for the **C**ockpit, Before Start, After Start, Taxy, Take-off, Approach, Final, and Leaving The Plane checklists, too).

Perform the BA COCKPIT SAFETY *and* BEFORE START CHECKLISTS [34] *(as with all these checklists, if any items have not explicitly been checked so far (e.g. oxygen and passenger signs here), then* CHECK THEM NOW*!:—*

Cockpit safety checklist:
Battery switch
Standby power switch
Hydraulic demand pumps
Windshield wiper switches (In version 1.3 of PS1, these are no longer present)
Alternate flap selector
Landing gear lever
Flap position indicator and lever

Before start checklist:
Int/ext preparation (Use your imagination with this one ☺)
Oxygen
Flight instruments
QNH
Park brake
Fuel control switches
Autobrake
Passenger signs

(From now on, the detail of these checklists will be left to the F/O).

Select the *large CDU*:—

- Press the INIT REF button to get PERF INIT page

- Enter the Zero Fuel Weight (219.2 Kg was the figure) using the s/pad and LSK 3L

- **C**onfirm the Gross Weight figure, if necessary (GR WT). (i.e. If it’s displayed in small font, press LSK 1L to change it to large font)

- Press LSK 6R to get to the THRUST LIM page

If you don’t want to change anything on this page, you could simply press <F6> again to reach the Take-off page (and skip this whole section). But if you *do* want to use these options, then you will find that take-off thrust limit options can be set using <2> to <4> (TO = full, TO 1 = de-rated 5%, and TO 2 = de-rated 15%), whereupon the corresponding climb

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[33] In respect of this, Hardy comments: “BA (and some other airlines) don't say "completed" after the **C**ockpit **C**heck List. I don't know why”.

[34] Hardy also points out that ‘**C**hecklist’ is yet another of those Aviation terms which have specific meanings over and above their vaguer use in everyday speech — a ‘checklist’ is something which you use to confirm that required actions have been completed (*after* they have been done). A ‘list’, on the other hand, is something you use *before* you perform the action. So most of this Tutorial is your to-do list, which is also punctuated by the various checklists to ensure that you really have done certain necessary actions.

thrust limit options will be armed — although you can change them using <F2> to <F4> (full, de-rated 10% and de-rated 20%). Since using the full take-off power of our engines with such a comparatively light aircraft would give us a startlingly high climb rate, on this occasion we will use TO 2, so:—

- Press <4> (or click LSK 4L): you will notice that TO 2 becomes <SEL>ected and CLB 2 is also <ARM>ed for when we enter the climb phase. The thrust mode is shown top right on the upper EICAS (and should now read 'TO 2'). Verify that the take-off EPR thrust figure shown top right on the THRUST LIM page is also displayed on the upper EICAS for all 4 engines.

You may have noticed "TAT +3C" just to the left of "TO2", so a brief word about temperatures may be useful at this point: I was certainly confused about them until Hardy straightened me out. He first defined the following:—

> "OAT = SAT = Outside or Static Air Temperature (independent of airspeed)
> TAT = OAT + the heat produced by the aircraft's airspeed (the faster, the hotter. This affects not only the air flowing through the engines but also the temperature inside the wings, and therefore the fuel temperature)."

Hardy continued:—

> "The temperature in white on the upper EICAS is TAT, not OAT. Additionally, you would also see a green "assumed temperature" display if you had de-rated your take-off thrust by means of entering an 'assumed OAT' (to fool the FMC, so to speak). The blue temperature is fuel temperature, but there is no OAT on the upper EICAS".

The measured Outside Air Temperature is displayed mid-way between the <1> and <F1> LSKs on the Thrust Lim screen (a bit chilly — this should confirm what you already have from ATIS, and noticed during Pre-Flight). The thrust mode and the EPR [35] limits corresponding to the take-off mode you selected will be displayed adjacent to the top right LSK <F1> and also at the top of the upper EICAS display, and should be checked for acceptability. Hardy also mentioned de-rating by means of an assumed temperature (see the tables on pp 248 – 251 in the PS1.3 manual), although this is not really a technique for beginners: briefly, this uses a higher "assumed temperature" in °C (for a given aircraft weight) which is entered into the top left hand corner of the Thrust Lim page — the thrust mode then shows 'D-TO EPR' ('D' for de-rate) and 'D-TO' is also shown in green on the top line of the upper EICAS display, followed by the value you entered. The FMC will also suggest the optimal climb thrust de-rate based on that temperature, but you can override this if you wish.

- Press LSK 6R (<F6>) to reach the Take-off page. Note that the climb mode we selected on the previous page (CLB 2) is shown in large font roughly in the middle of the display, and on the left of that is the thrust reduction height at which our take-off thrust will be reduced to CLB 2, i.e. 3,000 ft.

We are about to select a take-off flap setting and perhaps an acceleration height, so a brief word about these is probably in order at this point. Take-off flap is a function of aircraft

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[35] In airline configs which use CF6 engines, these figures would be N1.

weight and available runway length[36]: the heavier the aircraft and the shorter the runway the more likely you will be to prefer flaps 20° to flaps 10° — you get more lift but, of course, more drag, albeit that your stall speed will also be lower. These lift/drag trade-offs are also relevant when you consider your acceleration height:— the height at which VNAV decreases pitch to gain speed to allow flap retraction. Gaining that speed enables you to bring in the flaps which again reduces drag, thus giving you more acceleration and more speed, until when the aircraft is totally 'cleaned up' and your speed has increased you can increase your rate of climb again. Other factors such as the terrain surrounding the airport and noise abatement requirements will also be taken into account when deciding the acceleration height, of course [37]. Anyway, in our current example we will use flaps 10 (we are very light, needing comparatively little fuel for this short trip) and the default thrust reduction height of 3,000 ft[38].

- Check, and if necessary enter via <1>, the take-off flap setting (10°). The acceleration height (at which the pitch is reduced in order to start increasing speed) defaults to 1500 ft.

- (If required, vary the acceleration height to be used in the event of engine failure at take-off. <2>)

- (If required, enter the runway Upslope or Downslope, and the Headwind or Tailwind <4>.)

- We need now to enter W or D (wet or dry) into the scratchpad and press <5> to establish the runway condition. It is definitely raining out there (as was set on the Departure WXR page) and the effectiveness of the brakes is therefore reduced, so enter W.

- *IF THE V SPEEDS ARE NOT PRESENT* (and you're sure that you really have entered gross weight, zero fuel weight, runway, take-off thrust mode, runway condition, and flap setting) then re-enter your flap setting and press <1>. This often — in fact, usually — cures the problem.

- Confirm the V speeds which have been calculated for you by pressing <F1>, <F2>, and <F3>. *Remember the figure for V2*, you're going to enter it into the MCP in a minute.

- Enter the CG value which you noted on the Instructor's Page (rounded to the nearest whole number of percent) and press <F4>. The FMC will calculate the required number of stabilizer trim units to be set — you should make a note of this for later on.

Press the VNAV button <7> on the FMC to get to the VNAV page for the Climb (page 1 / 3).

- If it is incorrect, enter the Transition Altitude for your current location (TRANS ALT) by typing 6000 and pressing <F3> (6000 is for the UK, of course — it would be 18000 for the

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[36] Doug Snow's excellent PS1FPLAN (a ShareWare Flight Planner and Take-off Performance calculator based on Excel97) will give you this sort of information *and in considerable detail*. You can download an evaluation copy from http://www.ps1fplan.com/

[37] Hardy comments: "The take-off flap setting depends also on the obstacle clearance ahead and the runway conditions. Either rotate late and climb quickly (flap 10), or rotate early and climb slowly (flap 20). High obstacles close ahead, small obstacles far away . . . or vice versa. That's the question."

[38] Although not recommended, this 1500 ft default could be changed if required using the PERF FACTORS page.

USA etc., so use the correct figure depending on where you happen to be. Execute any change you make.

- If it is desired to enter a manual speed/altitude restriction (below your cruise altitude), do so in the format SSS/AAAA and press <4>. See page 84 for information about entering speed and altitude constraints.

Concerning the above two bullet points, Hardy adds the following:

“The purpose of speed restrictions on the VNAV page is to adjust VNAV performance predictions, as the speeds are subject to public airport terminal regulations. This way, the speeds on the LEGS pages can remain in small font, and stay ‘dynamic’, and yet not infringe any speed limits”.

(Note the strong hint that in general speeds on the LEGS page should remain in small font. Following the 1.3a upgrade — and in line with the real aircraft — you are prevented from ‘confirming’ anything at cruise altitude, anyway. The significance of a small font on *other* pages may be that so far these figures are unconfirmed — quite often on the Perf Init or Take-off Ref pages, for example, you will find yourself ‘confirming’ such figures, whereupon they appear in large font — so as a general rule *don't change them to large font in the LEGS pages* where you normally need to retain as much flexibility as possible. The meaning of small and large fonts on LEGS is quite different: here, large font means **this is now a constraint**. Changing these small font figures to large font would set them in concrete and cause the FMC to have to work round them rather than recalculating them on the fly (sorry!) in the usual way. Appendix 6 has more information about entering information and constraints into the LEGS page).

Now go to the *AFDS MCP* (glareshield Mode Control) Panel:—

- Enter your V2 figure as the MCP speed [39] by right or left clicking to the right of the MCP knob, and check that it is also shown in magenta on the top left of the PFD.

- Press the LNAV switch — and check the PFD indication (in white, i.e. armed)

- Press the VNAV switch — and check PFD indication (in white, i.e. armed)

- Dismiss large CDU

[IF you have been using External Power, follow this (indented) section

EICAS "STAT" display	Select
Go to the *ELECTRICAL panel* —	
APU selector	Start then On
APU AVAIL lights	Check Lit

---

[39] When I first began with PS1 I was (wrongly) in the habit of setting V2+10 here, but Hardy put me right, and also clarified the ‘+10’ business — thank you again, Hardy!: “V2 *alone* should be entered in the MCP, not V2+10. To have an exact speed bug in view for V2 is very important, especially when an engine fails after take-off. *VNAV will automatically add 10 knots when you have reached a safer height later on.*” So those checklists which state that you should enter V2+10 kts are wrong, although you can see why their authors might have arrived at that conclusion.

Push APU GEN 1	Wait a second (automatically disconnects EXT 1)
Push APU GEN 2	Wait a second (automatically disconnects EXT 2)
APU GEN 1 and APU GEN 2	Check lights are On]

Now it's time to get moving (literally)....

- Request ATC pushback and start clearance (using the **H** key [40] when not in FMC input mode — note and then enter the squawk into the transponder using the X key followed by the 0 - 7 keys on the numeric keypad — sorry laptop users, but this time you'll have to use NumLock!)

- Go to the *HYDRAULIC* panel:—

- Set Hydraulic Demand Pump no. 4 to AUX

- Set the other pumps (1, 2, and 3) to AUTO

- Set the Parking Brake OFF for pushback

(Once the ground engineer — thank you, Ian ☺ — has confirmed the removal of the towing system and steering pin, a message on the Ground frequency should clear you to rwy 05, then give you the QNH [41] and the Tower frequency. Change to that frequency (118.80) — if you were intending to continue with ATC after take-off you would also pre-set the Departure frequency in standby at this point, but that isn't really necessary this time since I'll relay any en route ATC messages to you during the Tutorial ☺).

Go to the *PNEUMATICS* panel:—

- Set Packs 1 and 3 OFF

Go to the right hand side of the glareshield panel:—

- Select the EICAS DRS display

(Below PFD centre)

- Set seatbelt signs to ON (if this was deferred from before)

- Reset the elapsed time to zero (press control and backspace simultaneously)

Go to the *MISCELLANEOUS* panel:—

- Set the anti-collision BEACON to BOTH (the doors will now start to close).

---

[40] Note that ATC must be enabled on the Instructor's Page (Text, Sound Blaster, or both), and your comms radio must be properly tuned to the Ground frequency (which it should already be, if you have been following the Tutorial faithfully).

[41] Hardy points out that this term may not be familiar to people from the US, for example. It gives you your **current altimeter setting**, which you need to cross-check (and, if necessary, adjust) with the setting as it is displayed at the lower right corner of the PFD. (The Q codes are discussed in a footnote on page 90).

Go to the *Main* panel:—

- Set/check that the Stabiliser Trim is within the green band for take-off and that the correct number of units (as were shown on the FMC when you entered the CG) are set. (If you are using the '2' and '8' keys on the numeric keypad rather than the mouse, toggle '7' whilst watching the bottom right hand corner of the outside display to ensure that you are in STAB trim mode rather than ELEVator mode!).

- Set/check that the Aileron Trim is centred at zero

- Set/check that the Rudder Trim is centred at zero

Go to the right hand side of the glareshield panel:—

- Remove all Upper EICAS caution messages (press the CANCel switch until no amber messages remain)

Perform the BA CLEARED FOR START *checklist:—*

Hydraulic Demand Pump #4 (etc.)

- Check the EICAS DRS display to ensure that all doors are closed and set to Automatic

- Set the EICAS secondary ENGine display

- Check the duct pressures for engine start on the Upper EICAS display (both should be over 20)

Prior to starting the engines you could brief the crew about the take-off and departure procedures (you're on your own with this one, but it's useful to get the procedures clear in your head — so don't feel silly if you do this out loud). Hopefully, there will be no problems (none that I have programmed in, anyway) but we do the briefing anyway as a matter of getting into good habits.

> "There are no NOTAMS or aircraft despatch deviations to affect the departure. The runway state is wet. On take-off if any malfunction is identified I will decide whether to stop or continue. Up to V1 I will stop for any fire, or an engine failure indicated by two or more parameters. To stop I close the thrust levers and apply manual maximum braking (as a precaution although the brakes are primed for Rejected Take-Off) whilst selecting maximum available reverse thrust and checking that the speedbrakes have deployed.
>
> "For any emergency after V1, I will confirm the nature of the emergency once we are safely climbing away with the gear selected up. I will then action the emergency according to the QRH [42].
>
> "We're very light with comparatively little fuel on board for this short hop to London, so it's a flap ten 15% fixed derated thrust take-off from 05. The instrument departure we can expect is a New Galloway One Juliet. After climbing straight ahead

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[42] See Appendix 12 for some details of Abnormal Procedures, although the QuickReferenceHandbook to use in the case of emergencies is to be found on pages 293 to 315 of the PS1.3 manual.

to a minimum of 2,000 ft at GLG, we turn left to follow a radial of 240 from PTH, reaching an altitude of 6,000 ft by the time we cross the 020 radial from TRN. We then remain at 6,000 ft until we receive ATC clearance to climb, turning left again at the 013 radial from TRN onto 189° to NORBO, where we turn left again onto 146° towards NGY".

So now it's time to light 'em up!

[N.B. With some configurations Autostart is not available — so the engines will need to be started manually [43] *]*

Go to the *FIRE* panel:—

- Set the FUEL CONTROL switches 4 and 3 to RUN

Go to the *ENGINE START+FUEL* panel:—

- Pull ENGINE STARTER switches 4 and 3, which should light up in white during the start [44]
- Monitor the engine indications on both the upper and lower EICAS during the start.
- Hardy tells me that as well as watching for increasing oil pressure [45] you should also:—
    - ♦ Check the FF indicator to ensure that the autostart system adds fuel at about 30% N3
    - ♦ Then check that the EGT doesn't rise abnormally quickly, and doesn't reach the red line
    - ♦ Check that the starter motor does not exceed the max motoring speed of 50% N3 (at that RPM the starter switch should snap in).

Half a minute later, N1 should stabilise at approx. 22 to 24% (or the EPR equivalent of somewhere around 1.00 with RR engines).

Go to the *FIRE* panel:—

- Set FUEL CONTROL switches 2 and 1 to RUN

Go to the *ENGINE START+FUEL* panel:—

- Pull ENGINE STARTER switches 2 and 1 (also white during start)

---

[43] The procedure for starting the engines manually is described by Mel Ott on page 337 of the PS1.3 manual. (If you have an AutoStart switch fitted in your configuration, ensure that it is in the OFF position). Start the engines *one at a time* (4, 3, 2, 1) by pulling the start switch, switching the fuel control to Run at the magenta line in the case of CF6 and PW4056 engines or 15% N2 in the case of Rolls Royce, and **monitoring** for a normal start as described by Mel.

[44] When no engines are running the bleed air to start them is provided by the APU. Pulling the start switches opens both the start and engine bleed air valves to transfer bleed air to the starter motors, and the illumination of the switch confirms that bleed air is flowing.

[45] For CF6 engines, you need to check for (a) Rising EGT after approx 15% N2 (the magenta line, if shown in your config), and (b) Oil pressure and N1 rotation at idle N2 (as well as increasing oil pressure).

- Monitor Engine indications on upper and lower EICAS during the start (as for 4 & 3)

Go to the *HYDRAULICS* panel:—

- Set No. 4 hydraulic demand pump to AUTO. (Its PRESSure light should be extinguished and the cautionary EICAS message removed).

Go to the *MISCELLANEOUS* panel:—

- Set the nacelle anti-ice switches to ON if icing conditions prevail (they do, at Glasgow in the Tutorial, but when flying other trips you will get this information from the Departure WXR page during Pre-Flight, as mentioned on page 21).

Now confirm and note your "off block time" from the clock.

Go to the *ELECTRICAL* panel:—

- Set the APU selector to OFF (the whole shutdown sequence takes about a minute, but it is automated, so you can carry on without having to wait. Also, there's no need to touch the APU gen switches, since the engine generators automatically take over from any previous power source).

Go to the *PNEUMATICS* panel :—

- Set all 3 pack selectors to NORM

Also, press the EICAS RCL button and check for any significant EICAS messages.

Check that the OIL Qty on the lower EICAS.

Receive Taxy clearance.

Perform the BA AFTER START *checklist:—*

APU selector (etc.) (Don't worry about Aft Cargo Heat in this config)

Check that the Taxy area is clear (usually a safe bet in PS1, but rather the reverse in real life).

Release the parking brake.

Start to taxy to the correct runway threshold [46] (use the ND set to MAP on the EFIS panel with 10 mile scale to help you reach the runway threshold — taxying in PS1 with a limited

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[46] In order to taxy, apply throttle using the mouse (or <keypad 9> increases the throttles, <KP 3> decreases) to get the plane moving, then put the throttles back to idle (the plane will still slowly accelerate, under most conditions). **Don't exceed 20 - 25 kts when taxying** (check your ground speed at the top left-hand corner of the ND) and slow down when cornering. Once you have achieved the required speed, set the engines back to idle. Move the mouse to the bottom of the screen and you will see STEERING TILLER written in brown at the bottom of your outside view. Click and hold the left mouse button and drag the mouse in the direction you wish to turn the nose of the plane — releasing

outside view is not easy [47]). Start off by taxying parallel to the runway, then slow down and turn through 90° when you're level with the end and head towards the threshold. Note that the cockpit should be 20 feet past the taxyway centreline before initiating a turn on, or you'll find your main gear on the grass.

- Whilst you're taxying, on the *Main* panel set your take-off Flaps as entered in TAKE-OFF REF — 10 in this case. (Note to MSFS users — flaps 10 will not be achieved instantly!).

- Press the STAT button to set the EICAS STATus display

- Verify control deflections: if you have a joystick, press the STAT button on the lower EICAS display panel, and verify that complete deflection (movement) of the Elevator Aileron and Rudders takes place as you move the controls.

- Push the EICAS STATus button again to blank the lower EICAS

Select the VNAV page on the FMC to view the Climb page

Perform the BA **BEFORE TAKE-OFF** *checklist:—*

Vital data (etc.)

This is also a good time to check and fix in your mind the take-off performance speeds.

On nearing the runway threshold: STOP — await ATC clearance to proceed ("Line up and hold") before turning onto the runway. While you're waiting:—

Go to the *PNEUMATICS* panel:—

- Set PACKS 1 and 3 OFF (we're light today.....) [48]

Go to the *MISCELLANEOUS* panel:—

- Set both Inboard and Outboard landing lights ON

- Set Strobe lights ON

Go to the *Mode Control Panel* on the glareshield:—

- Set the Autothrottle ARM switch to ON

Confirm take-off flap setting and thrust rating.

---

the mouse button centres the nosewheels again. The brakes, when you need them, are activated by the space bar.

[47] The TWY utility from Ivan Ngeow can help enormously at airports for which SCT files are available — use the Search function on the Aerowinx board to find details, and you can download the utility itself from "Support | Add-Ons and More".

[48] Hardy comments that "....for this light aircraft you actually don't need to turn any packs off at all", which whilst perfectly true is somewhat unusual — so for the sake of getting into good habits let's pretend we're about to do thousands of miles rather than a few hundred. ☺

When cleared to "Line up and hold" —

- Turn onto the end of the runway.

- Ensure that the aircraft (and the nosewheels) are lined up with the centreline (a bit harder to do in PS1 than in real life?)

- Stop again to await take-off clearance. (At these cold temperatures, and also because we are distinctly lighter than usual, you may be wise to apply the handbrake to make sure she doesn't start to move forward without you noticing — yes, even at idle thrust!)

- Now is the time to turn on your weather radar using the WXR button on the left of the glareshield (you have considerately left it turned off until now to avoid the ground staff, and the staff and passengers in the aircraft in front of you in the take-off queue, suffering any ill-effects).

(In the simulator, this could also be a very good moment to save an INI file in case you want to restart from this point — but don't forget to Save *AS*, or else you'll overwrite your original INI. A final comment: the flight which follows is a realistic and fairly busy one into one of the world's busiest airports. In spite of my earlier comment regarding the use of Pause, you may from time to time find it helpful to Pause the simulation whilst you are reading through the explanatory passages in the pages which follow — the first few times at least and especially when it comes to the descent — since you'll find there's quite a lot to do! What would be high workload situation for two pilots means you are going to have to really concentrate on your own. ☺).

At last —

YOU'RE ON THE RUNWAY —

YOU'RE READY TO BE **C**LEARED FOR TAKE-OFF!

When you *are* cleared for take-off, carry on with section 2.

SECTION 2 — take-off, en-route, and landing

Take-off

Once you receive ATC take-off clearance (the current wind information followed by "Cleared for take-off") then it's time to go. You'll hear from PS1's ATC again on this trip — signing you over to Departure — but not much more in this exercise (unless you change the ATC settings, of course) other than bits that I throw at you to make life more interesting ☺ .

OK, this is it. Recall before you start that the take-off and landing phases are "high workload" for *two* people, and you're going to have to manage this *all on your own* — albeit with a lot of assistance from the automatics. Also, the pace of events here is slightly unusual: in this scenario we are unusually light for a 747 take-off, so our rate of climb will be faster than normal — and hence things will follow each other more swiftly than would otherwise be the case. It may help if you try and memorise as much as possible of the following list (you are going to be rather busy for the next minute or so . . . .).

- Release the brakes (and check that the EICAS message has disappeared).
- Reset the elapsed time on the clock by pressing the <Ctrl + Backspace> key combination. (See Appendix 16 for a brief discussion about the clock, chronograph, and elapsed time).
- Mouse the throttle halfway (to approximately 70 - 80% of N1), and verify that the engines are stable.
- Press the TO/GA switch and check that THR REF mode is annunciated on the PFD. Hardy adds that at this point you should also verify that the aircraft symbol is aligned with the runway threshold on the ND (for an IRS check).
- Verify at 80 kts — the First Officer will announce "80" — that "HOLD" is displayed on the PFD (as it should have been since 65 kts in fact, but the F/O's announcement is a good time to check) and that *your* instruments show 80, too. Say "Checked." [49]
- When you hear the "V1" call, remove your hand from the throttles (if you are using external hardware) — you are now committed to take-off.
- Rotate (at 2° per second) when you hear the F/O's "Rotate!" call, but be careful — don't pull back too much too early (i.e. keep your pitch < 11° until clear of the ground) or a tail strike will occur. Use the Flight Director commanded attitude and you'll be fine — keep the little white dot on the FD in the centre of the two magenta lines. It will take a few seconds for a positive rate of climb to be established and shown on the PFD [50].
- Check the right side of the PFD for a positive rate of climb of at least 500 fpm *as well as* an increasing height indication, and then retract the gear by pressing <G> *twice*. (MSFS users with standard cockpits in particular, please note!). Check the gear retraction indications on the upper EICAS — once retraction is complete the EICAS indications will eventually disappear if all is well.
- Click on any autopilot CMD button (or press <A>) to activate the Autopilot as you are passing through 250 feet (or you may prefer to await VNAV engaging at 400 ft AGL).

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[49] Hardy adds: "If you don't speak, your F/O has good reason for thinking that you're suddenly incapacitated, and hence would abort the take-off immediately. No captain = no flight".

[50] Be prepared for LNAV to be annunciated at 50 ft AGL (Above Ground Level). Note, however, that although the roll *annunciation* should change to LNAV, this won't affect the aircraft until you engage the AutoPilot.

- Don't forget to continuously monitor both your speed and altitude during all this — in your spare time ☺ . But it definitely pays to keep checking what all that automation is doing — and that it's doing it properly.
- (Select VNAV mode if not previously selected — some configs).
- At flap acceleration height (1500 ft AGL in our case) VNAV moves the speed bug to the greater of (V_{REF}+100) kts or 250 kts, and the flight director lowers the nose so that we can accelerate to that speed. When the aircraft starts to accelerate, you will need to begin your flap retraction sequence as indicated by the green speeds on the right hand side of your speed tape on the PFD (see below).
- Check in the upper EICAS that CLB (or CLB1, CLB2 as appropriate) thrust is set at the appropriate thrust reduction height (also switch in LNAV at this point, if it is required and not yet engaged — some configs).
- Retract the FLAPS according to the flap retraction speeds shown on the PFD speed display (<F9>) [51]. For example, when the green 5 descends to be centred on the tape (and not before!), select flaps 5. (Continue the retraction sequence until the flaps are fully up).
- Go to the *PNEUMATICS panel* and **set all three** packs back to NORM.
- **Set** the anti-icing switches back to AUTO if you turned them on prior to take-off (or set them as conditions require).
- After flap retraction is complete, check that the gear display has been removed from the upper EICAS and then **set** the gear to OFF (to depressurise the gear hydraulics) by pressing <G>. Some Companies switch off their inboard landing lights at this point, too.

Once the aircraft is clean,

call for (and action) the BA **AFTER TAKE-OFF** *Checklist.*

Don't contact Radar (Departure) on 119.10: I'll provide you with a few ATC distractions along the way — to try and demonstrate a few points — as you are about to discover ☺ .

At this weight you should have no difficulty about being at greater than 2,000 ft as you reach GLG, and the aircraft will then begin a U-turn to the left (there's some rather high and rocky ground immediately ahead of you!). When you reach the TRN 020 radial you must be at (and the SID calls for you to *remain* at until NGY) 6,000 ft, which will be taken care of by the FMC entries. You will then (after TRN020) be flying straight towards your next waypoint, so *you should adjust the heading knob to agree*: you will see the dashed magenta line moving on the ND as you turn the knob, so adjust it until it lies along the magenta line which represents your course as programmed. Turning the knob won't actually change anything, since you are presently in the (relatively) safe hands of the autopilot, but in the event that you should suddenly have to take control for any reason it is helpful if you don't have to then mess about with knobs and so on whilst you are presumably dealing with something unexpected.

Once you gain a little more confidence with the sim, you may choose to take the option which many people prefer, which is to fly the takeoff themselves, not using the autopilot but following the Flight Director's suggestions about where the nose should be pointed. Obviously you will need a yoke or a joystick, and if you hand-fly the landing you will very probably need rudder pedals as well if there's a cross-wind, but in this Tutorial we will stick to letting the built-in automation handle all the hard stuff for us.

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[51] In general, fly at 10 kts more than the flap setting speed shown in green on the PFD's tape. So with flaps 10, fly between the green10 and 20 on the tape — although at the moment you are more concerned about cleaning up the aircraft (no flaps, no dangling Dunlops) as soon as you can. The speeds for selecting different amounts of flap are perhaps most significant on the approach when you start reducing speed and working right through the range towards full flap (see Appendix 10).

The SID here — see Appendix 14 for details — calls for us to remain at 6,000 ft for an unusually long time if ATC are too busy to clear us soon! Fuel burn is far from efficient at this height and, of course, we are limited to 250 kts below 10,000 ft so our progress is not as fast as we would like. So (having established that there is no conflicting traffic) my first act as your stand-in ATC is to wait until you are established on course towards NORBO [52] and then clear you directly to your cruising altitude, and also directly to DCS. What do you need to do to put this into effect?

If the LEGS page is not currently displayed, open the large version of the FMC and click on the button to display it. At the top of the page you should see NORBO, then NGY and DCS. All we have to do is press LSK 3L to put DCS into the scratchpad, then LSK 1L to overwrite NORBO. The EXEC button now lights up and so we press that, too, to confirm our intention. You will see the magenta line on the ND switch to point towards DCS (although you may have to change the scale to 80 or even 160 miles to see DCS itself) but you will notice that although the aircraft has turned towards DCS, in spite of there no longer being any altitude constraint in force on the FMC it does not begin to climb. If you're not sure why this should be, think about it for a moment and try and work it out. (Answer coming up).

You may recall that, along with always changing the heading knob to agree with our course (you did remember to turn the knob at the course change when we EXEC'd the change we made in the FMC, didn't you? ☺) we should always set the altitude window on the MCP to agree with our next constraint — which until a few moments ago was 6,000 ft. That's why we're not climbing, so we now need to turn the altitude selector until our cruising altitude of 29,000 ft appears in the window, and push the knob. Immediately, the aircraft starts to climb — and since we have now passed the 6,000 ft Transition Altitude for Glasgow, we also need to set the Altimeter to STD (see below).

Climb, and forecast winds

If you look on the ND, you will notice a small green circle labelled "T/C" on the magenta line between our present position and DCS. This is the projected point for our Top Of Climb — in other words, the point at which we achieve, and maintain, cruising altitude.

- During the climb, monitor the climb rate and other indications on the PFD: you should see the following modes at this point — THR REF (autothrottle), LNAV (roll) and VNAV SPD (pitch)[53].
- Set the CDU page to VNAV to monitor the climb parameters.
- Press the STD knob to set the ALTIMETER to STD (29.92 Hg / 1013 hPa) when passing through the Transition Altitude (6,000 feet for much of the UK [54], or whatever the TA may be depending on where you are — you should hear the F/O call "Transition Altitude").
- Verify that the altitude you are cleared to (or your cruise altitude if there are no further constraints) is set in the MCP window.
- Select wing and nacelle anti-icing controls as required by the conditions (*MISC panel*). Hardy comments: "You might want to have NAI and perhaps WAI ON (if not already switched to AUTO) if the TAT is below 12° C and you encounter clouds or rain or fog. Remember too that Continuous Ignition is automatically activated if you have NAI on —

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[52] Did you remember to reset the heading knob at the TRN013 waypoint?

[53] See Appendix 5 for more information on these annunciated modes.

[54] If we were at Manchester, for example, it would be 5,000 ft.

although the EICAS memo message 'CON IGN' is only displayed if you *specifically* set Continuous Ignition ON".

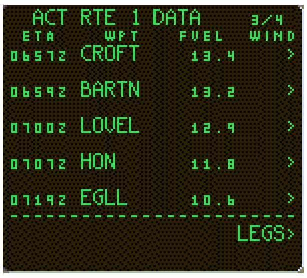
- After passing 10,000 feet go to the *MISC panel* and turn inboard and outboard Landing Lights OFF. Also set the cabin signs as required (in line with Company policy). This usually means setting them both to AUTO (although BA flights are "designated non-smoking").

While you are climbing to your cruising altitude, it's a good idea to start to think about the wind — no, not your digestive problems, I mean the wind at our waypoints.

"But why?", I hear you ask. In answer, allow me to quote from the ultimate guide to the FMC — the "Big Boeing FMC User's Guide" by Bulfer and Gifford: 'If no wind entry is made on any waypoint WIND page, the FMC assumes that the forecast wind is zero in its time and fuel estimates!'. (And the exclamation mark is theirs, not mine).

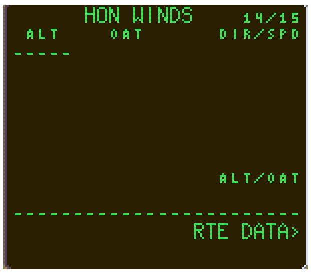
In other words, if you don't do anything about it, the FMC's calculations could contain significant errors — which you need like the proverbial hole in the head, right? So we had better give the tin brain something reasonably accurate to calculate with.

Do you by any chance remember me going on about making a note of the wind at 35,000 ft as shown on the WXR 3 page of the Instructor's page (way back on page 21)? Well, this is where that information is needed, since there's effectively nowhere else up here that you can find it [55]. If we were on a long trip then I would use additional information from WXR 1 and WXR2 as well, but on this short hop there won't be much change in the weather as we head southwards, so we will enter the wind at the last waypoint of our route (HON), which is why we looked at WXR 3. This wind entry will then propagate backwards to the first waypoint. Hardy says: "The advantage of doing it this way round is that waypoint wind data won't be deleted as you pass the waypoints during the flight". So let's do it.



```
   ACT RTE 1 DATA        3/4
  ETA      WPT     FUEL  WIND
06572 CROFT        13.4     >

06592 BARTN        13.2     >

07002 LOVEL        12.9     >

07072 HON          11.8     >

07192 EGLL         10.6     >
-----------------------------
                        LEGS>
```

Select the LEGS page on the FMC if you're not already looking at it, and use the Next or Previous page buttons to find the page containing HON. Now press <F6> or click on LSK 6R at the RTE DATA prompt. You should see a screen looking something like the one at the left: notice in passing that your ETA at each waypoint is given along with the anticipated fuel remaining, and there's an additional prompt on the right under the "WIND" column. Click on the right LSK on the HON line.

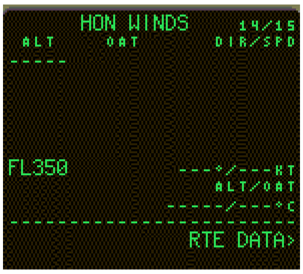


```
         HON WINDS       14/15
  ALT      OAT        DIR/SPD
-----








                      ALT/OAT

------------------------------
                     RTE DATA>
```

The screen you get now is, at first sight, pretty boring, but that's simply because we haven't made any entries in it yet. We're going to enter the wind data from the last stage of our cruise that we got from the WXR 3 page (where we learned that the winds at 35,000 ft were likely to be fluctuating around 081° at 35 kts).

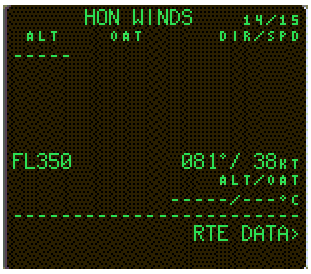
---

[55] OK, I suppose you could press escape to leave the cockpit now and have a look, but I take the purist view that once you're up there you're on your own, and entering the Instructor's Page is cheating. But it's your choice. ☺ But there is just one other non-cheating possibility: Hardy points out that "As a bonus in the sim, the TAF telex in ACARS also includes the winds aloft" . . . . .



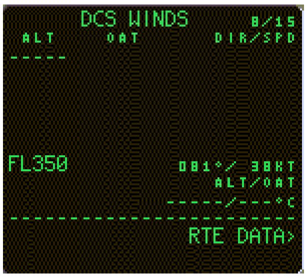
```
    HON WINDS         14/15
 ALT       OAT      DIR/SPD
-----



FL350            ---°/---KT
                    ALT/OAT
                -----/---°C
---------------------------
                  RTE DATA>
```

First we'll enter the altitude of our forecasted winds. Enter 350 (i.e. Flight Level 350, 35,000 ft) into the scratchpad and click the LSK alongside the dashed line under "ALT". Slightly surprisingly perhaps, the FMC chooses to put that value towards the bottom of the page, and opens up an additional prompt to the right of it for entering our forecasted wind direction and speed at FL350.



```
    HON WINDS         14/15
 ALT       OAT      DIR/SPD
-----



FL350            081°/ 38KT
                    ALT/OAT
                -----/---°C
---------------------------
                  RTE DATA>
```

Type 081/35 into the scratchpad, and press the Line Select Key alongside the dashed lines for entering wind direction and speed. This should result in something like the example on the right — so we now have some forecasted winds at our last waypoint, which will also propagate backwards to save us a lot of typing (we'll check that in a moment).



```
    DCS WINDS          8/15
 ALT       OAT      DIR/SPD
-----



FL350            081°/ 38KT
                    ALT/OAT
                -----/---°C
---------------------------
                  RTE DATA>
```

Finally, click on LSK 6R to get back to the RTE DATA page, and notice the "W", indicating a wind entry for HON. Although nothing has been entered for the others, the entry will have propagated backwards — if you want to check this, choose an early waypoint and go to its winds page. You should find the data there too, but (as you can see from the example on the left) in these cases the wind figures are in a small font, unlike the ones you entered for HON (compare the previous example).

How's the climb going? If you passed through 10,000 ft or perhapsTransition Altitude while you were busy typing and haven't taken action already, then do so now. And have you been adjusting the heading knob at each waypoint as the course changed? ☺

Cruise (and more winds)

- Level off at the cruise altitude (or check that VNAV does it for you).
- Check that the VNAV page indicates ECON CRZ. Notice also that the optimum cruising altitude (i.e. for most efficient fuel consumption) at our light weight is more like FL390 than our present 290: nevertheless, recalling the relatively short distance left to the Top of Descent point, today there would be little point in requesting the new altitude and getting up there only to have to start to descend again very soon afterwards. But if you did want to climb to a higher altitude (perhaps on your next trip ☺), it's simply a matter of getting clearance from ATC first and then entering the new value in the MCP window and pressing the button.
- Press the EICAS RCL button to make sure that you didn't miss anything in all the excitement.
- Press the PROG button on the FMC to display the flight's progress, predicted arrival times and fuel estimates. Note especially the distance to T/D (Top of Descent) at the bottom of that screen — hmm, we're going to be kept busy on this trip!
- Monitor flight progress, performance, navigation, and, of course, the fuel system.

To speed the flight (which probably won't be necessary in the Tutorial ☺), you could use MENU / SIM STATUS / JUMP TO the next waypoint (it takes around 20 seconds for the

FMC to re-synchronise itself each time). Exercise caution when doing this, however, since *the aircraft is moved horizontally but not vertically* — if you start this procedure prior to reaching your cruise altitude there will be unforeseen consequences . . . . . The bottom line is — **only use this technique to speed the cruise**, because it won't work for the climb or descent (which would be a bit like cheating, anyway).

A few miscellaneous items just to help you while away the time in the cruise — "dozin' for dollars . . ." — although on this particular trip you (rather unusually) will barely have time for a cup of coffee, let alone anything else ☺ ! If you have only 100 nm or so to run before the T/D *you would be well advised to skip straight to the 'Pre-descent' section*, right now!

- Monitor flight progress, performance, navigation, and, of course, the fuel system.
- Keep an eye on that PROGress page so that you can start to get busy again around 150 - 200 nm prior to the T/D point.
- If you receive an ACARS UPLINK message in flight, press the MENU button on the FMC, then press the button next to ACARS (<2> if the FMC keyboard mode is active) then received MESSAGES <F1> and then TELEX <5>. The message will be displayed. If it says "Holdings at Dest expctd, reduce speed, use cost index 17" (or whatever cost index is displayed) and you wish to comply with this [56] go to the FMC and press the INIT REF button, then press INDEX, then press PERF, then enter 17 (or whatever number was on the ACARS message) in the scratchpad, and then press <5> to move 17 to the COST INDEX entry.
- You need to avoid any storm cells which you see appearing on the ND's weather (WXR) display. If your course (the magenta line on the ND display) goes through one then you will need to pick a heading (and get it approved by ATC) that will take you around it with the minimum deviation. Work out your best strategy — perhaps the best option is to use Route Offset line on the Route page of the FMC to avoid the weather — see page 168 of the PS1.3 manual. Alternatively, you could use the quick way: enter the new heading via the heading select knob on the MCP, and click on the knob to put you into HDG SEL mode [57] and action the change. Once you've safely bypassed the turbulence, you could simply use LNAV (bearing in mind Hardy's comments in the footnote) [58] to let the FMC sort out the problem for you. So if you *have* deviated more than 2½ nm from your intended track, you will need to set a new heading (the *dashed* magenta line on the ND) which intersects your FMC course (the solid magenta line on the ND) and press LNAV once you've almost (i.e. less than 2½ nm away) rejoined it. Whichever way you choose, you've avoided upsetting the delicate digestive systems in Club Class [59] . . . .
- The same sort of procedures as discussed in the previous paragraph also applies if you should get a TCAS warning — except that in this case (depending on the severity) you may well feel the need to react rather more quickly! In this case, your altitude may well change too, and you'll need to sort it out with ATC once the danger has passed.

---

[56] You are the Captain, it's up to you!

[57] Owing to the problems which beginners can experience whilst changing modes, I have included an Appendix (Appx 5) which discusses the uses of the different modes and how to change between them.

[58] Hardy points out that "You must be within 2.5 nm of the current leg if you want LNAV to direct you back to the original route after you turned around a storm cell using HDG SEL. Also, if you then fly a heading with HDG SEL that would never recapture your LNAV track you would get the FMC message 'NOT ON INTERCEPT HDG'".

[59] But seriously: your evasive action has also meant that other and more potentially unpleasant possibilities — such as engine flameout — have also been avoided.

Once you get towards the end of the cruise — say, no later than 150 nm before your T/D point — it's time to start getting busy again.

- Press the EICAS RCL button to make sure that you didn't miss anything while you were indulging in deep and meaningful conversations with your favourite Flight Attendant, trying to decide between the rival detr… sorry *att*ractions of your airline's food, etc.

Pre-descent

Around 150 nm before the Top of Descent point:—

You're going to need to check Heathrow's ATIS and weather, and you will be able to get this information from ACARS, even if ATIS itself is not yet tunable on the comms radios.

I've been chatting quietly to London Control whilst you've been busy, and they have assigned us the Bovingdon 1A STAR from Honiley to BNN (with a warning that as usual we may need to hold at Bovingdon) and indicated that we should expect an approach to Heathrow's runway 09L. So with that in mind, let's have a look at the paperwork before we find out what's waiting for us at EGLL . . . . . (If this is the first time you have tried this, you may need to Pause the sim (just press the 'P' key) and study the charts until you are completely familiar with them).

Thanks to the kindness of Bertil Gullmar of Team FSS, Appendix 14 contains all the relevant charts: you will notice that the STAR takes us from HON via WCO to BNN — with plenty of opportunities for possible holds along the way! On the following page you will find the chart for an ILS approach to Heathrow's runway 09L. We will be starting from BNN, of course — at the top of the chart — and flying 222°, followed by a rather sharp turn to the left (hence the comment on that chart about being based upon a maximum IAS of 220 kts) and onto the ILS. Particular points to notice are the missed approach procedure (basically we climb on 040° to 3000 ft and wait for ATC directions) and the minima: in our case, the Decision Height for Cat II is 100 feet (AGL, i.e. watch the radio altimeter [60]).

OK (unpause the sim if you had paused it) now let's see what ACARS can tell us.

Press the MENU button on the big FMC, then click on LSK 2L for ACARS and LSL 1L for REQUESTS. Click LSK 2L for an ATIS request and LSK 2L again to make EGLL into large font, then click LSK 6R to SEND that request. Now click LSK 6L to get back to the index, 1L for REQUESTS again and this time 3L for a WEATHER request. Click on 2L again for EGLL and 6R for send, then return to the ACARS index page — we're about to get all the information we need (you'll get a message in the scratchpad saying ACARS UPLINK when it has arrived — just clear that message with the CLR key on the FMC or the backspace key on your keyboard).

What may surprise you is that one of the reasons we need this stuff is so that we can enter some more wind information. OK I know, I know — we've already done that. But that was the *en route* winds: we now need to tell the FMC about the winds and other issues during the *descent*, so that VNAV can have a stab at getting our descent profile reasonably correct. So where can we find the information that VNAV needs, I wonder?

---

[60] I just heard Hardy murmur something about ".... should have been called radio *height*...." ☺ Don't forget to take a look at his helpful graphic about decision height (and MDA) shown in Appendix 1.

Well there's one wind that we know quite a lot about, and that's the wind where we are right now (i.e. at 29,000 ft) as shown at the top left-hand corner of the ND — so hopefully it won't be too different when we get to our T/D point in ten minutes' time (or thereabouts). The other wind which we will soon learn about (as well as other useful things from the same source) is the wind that's blowing at our destination. The ATIS and weather info should be there by now, so click on LSK 1R for received messages, and 2L for EGLL's ATIS.

Lots of good things here: the first line gives us the version (Quebec, as I write this) and the time it was published (0620 Zulu), and then tells us the runway in use, which is 09L. The next line gives us the Transition Level, which is quoted as FL 070 (no doubt in view of the low pressure [61]). Then we get the wind — a friendly 3 kts without gusts at 080 ° — which we will also be able to enter into the descent forecasts, shortly.

The visibility is looking remarkably good at > 10 Km but overall the weather is looking a bit unpleasant — although at least the rain is a bit warmer than it was in Glasgow (for a guide to how to read weather details, which will also help you with the weather page we're about to look at, see Appendix 8). Finally the altimeter setting is 1011 millibars / hPa (29.85 inches), and it is not anticipated that there will be any significant changes in the weather in the immediate future. *Make a note of this stuff* — you'll need it, very soon. But to get more details (it really doesn't sound very nice down there) click on 6L to get back to received messages, then 4L for Heathrow's weather. Ouch! This, folks, is a TAF — an Aerodrome Forecast — which gives us even more details of what we have to face when we get to London. As you can see, it's written in a sort of code (which compresses the information substantially but hardly improves its readability) so at this point I can only commend to you the joys of Appendix 8. But for the benefit of those who would prefer to leave all that until another day, the bottom line is that the winds are light but it's rather horrible at Heathrow: TSRA means ThunderStorms and RAin, and we don't break out of the clouds until 2,100 ft, and the temperature is forecasted to be 9° C!

Now (as I'm sure you remember) a TAT of less than 12° when approaching cloud, rain, or fog constitutes *icing conditions*. We have two anti-icing systems, as controlled on the Misc page, and in the BA configuration they are Nacelle Anti-Ice (on/off/auto) and Wing Anti-Ice (on or off). Given the unpleasant weather at Heathrow combined with a temperature definitely hovering below 12° even at ground level, it isn't hard to decide to set the NAI to AUTO (although we must remember to check the upper EICAS to ensure that the green NAI flags are displayed at the right time, and if not switch the NAI to ON), but do we need to consider turning the WAI to ON when we get anywhere near the cloud (or rain, or fog ☺)? And when will that be — or rather, at what altitude? We need to know these things.

Taking the start of the cloud as 21,000 ft (from the Arrival WXR page, as we noted during our Pre-flight) and applying the rule of thumb of –2° C per 1000 feet up from Heathrow's 10 or 9 degrees (depending on which forecast you have most faith in ☺), it isn't hard to decide that we definitely need to turn on the Thermal Anti Ice by 21,000 feet, and hence we must notify the FMC that we're going to do it (there is no communication between the FMC and the TAI other than our entry into the relevant page). If you wonder why we need to inform the FM**C**, allow me to quote from the Bulfer and Gifford FM**C** "Bible" [62] —"**This entry has a significant effect on the vertical path, adding 20 to 30 miles to the descent** - over 5:1 ratio if a tailwind is present" — so therefore it's obviously somewhat vital that we get it right! (In the simplest terms, hot air is diverted from the engines to get the necessary de-icing warmth, so the idle speed of the engines needs to increase in order to provide it, and so we have to tell the FM**C** to take this into account). Stanley Stewart's book [63] adds this information to enable us to distinguish between the use of NAI and WAI:— " . . . . hot air . . . is available for anti-icing of engine nacelles and aircraft airframe. Engine anti-icing is frequently used as a precautionary measure, *but the big jets seldom experience conditions where airframe anti-icing is required*". (My italics). Hardy also adds: "Remember that WAI is physically ineffective if the leading edge flaps are out; and is also inhibited on the ground". So unless Britain is exceptionally chilly (even by British standards), we can very often use just the NAI and leave the WAI alone. (Which probably explains why the BA bean-counters declined the fitting of an AUTO option on the WAI: the BA 747 fleet seldom encounters the need for airframe anti-icing). [64]

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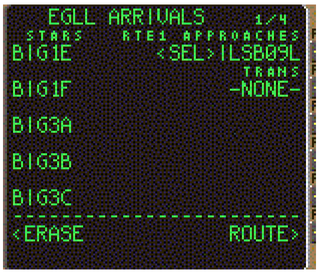
[61] The pressure affects the TL since a 1 mb variation translates to about 30 feet. Allow me to quote Adrian Smith (real world ATCO) on this topic: "Transition Level is 'The lowest Flight Level available for use above the Transition Altitude' (Quote from Manual of Air Traffic Services) so for Heathrow if the pressure is between 1014 and 1030 mb, the TL is 60. Above 1031 pressure (all in HectoPascals, or Millibars as I am more accustomed to) the TL is 50. Of course with the usual UK weather ☺ pressure tends to be below ISA, so from 1013 down to 977 the TL is 70, below 977 TL is FL 80".

So now we know the answer to the questions which were posed in the previous paragraph but one —we will either turn the NAI to ON at 21,000 feet or above [65], or, if we put the NAI into AUTO mode, that is the altitude at which it will probably get turned on by the sensors. So on this occasion, call up the Misc page and ensure that all four NAI selectors are set to AUTO and the WAI switch is at OFF, and we'll enter the 21,000 ft into the Descent Forecast page soon.

Sorry for the long explanation, but in these sorts of temperatures it's important! (You can also now begin to see why we started this exercise ten or fifteen minutes before we reached the T/D! ☺). OK, let's get all the necessary information into the FM**C**.

The first thing is to enter the information about our arrival into Heathrow: as things stand, the FM**C** knows how we will get to HON, and that we will ultimately end up at EGLL, but that's all. Now that we have got the approach from AT**C**, we need to get those details entered into the M**C**DU.



```
   EGLL ARRIVALS     1/4
  STARS     RTE1 APPROACHES
BIG1E         <SEL>ILSB09L
                     TRANS
BIG1F               -NONE-

BIG3A

BIG3B

BIG3C
------------------------
<ERASE              ROUTE>
```

Get the large **C**DU in place, put it into data entry mode, and press the DEP/ARR button to see the EGLL ARRIVALS page. We select from the right-hand column first, since this automatically restricts the left-hand column to only showing the applicable STARs. So click on the LSK alongside ILSB09L: it should now show as

---

[62] You need this book, you really do!

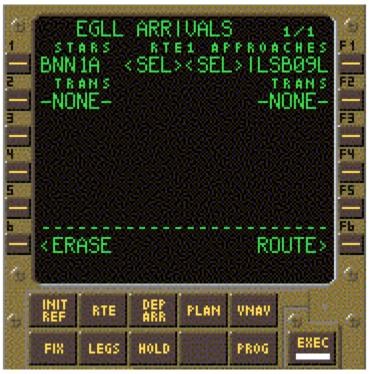
[63] You need this one, too ☺ .

[64] In further discussions with Hardy on this topic, he also added this additional distinction between the two systems: "WAI is also more critical regarding lateral balance. If one wing is inoperative, the other wing is deactivated, so that ice isn't built up on just one side. Better a well-balanced heavier aircraft than an unwanted roll tendency. As these jets usually don't fly very long in freezing conditions (i.e. low altitudes) like smaller aircraft, it's really not that critical, however".

[65] Rather than looking at the WXR page, Hardy says that he tends to take a pragmatic view of this, saying: "If I get an 'overcast' report I assume there's a big nimbus reaching up to FL100 and above. And if it's lower at the front, I'm sure that there are alto-stratus/cumulus on top. Of course, PS1 is very simplified in this area as it can only model 'overcast'. Generally, if you have really cloudy weather (i.e. 'overcast', not just 'stratus') at the destination, you can take it the clouds will reach far above FL100". As in the present case.

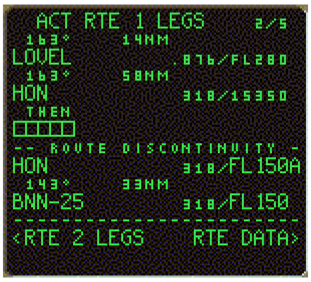
<SEL>ected.

Now we need to select the Bovingdon One Alpha STAR from the left-hand column. Using the Next Page button if necessary, click on the LSK next to BNN1A to Select this, too. The Exec button lights up, so click on it to confirm our choice.



```
    EGLL ARRIVALS     1/1
  STARS    RTE1 APPROACHES
BNN1A  <SEL><SEL>ILSB09L
  TRANS             TRANS
-NONE-             -NONE-





------------------------
<ERASE             ROUTE>
```

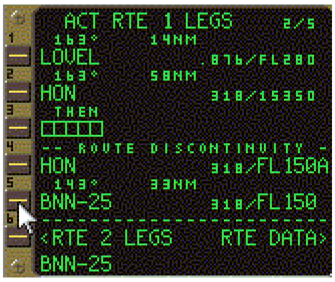
The ARRIVALS page now reverts to displaying everything, in case we should later need to change our minds (or have them changed for us, by AT**C**). The FM**C** now knows the details of how we intend to get from Honiley to Heathrow, but as always in these situations we need to ensure that the new route joins up properly onto the end of the previous one.



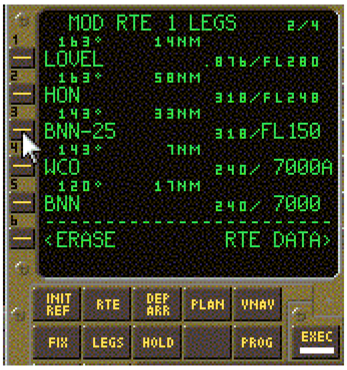
```
  ACT RTE 1 LEGS      2/5
 163°      14NM
LOVEL         .876/FL280
 163°      58NM
HON           318/15350
 THEN
□□□□□
-- ROUTE DISCONTINUITY -
HON           318/FL150A
 143°      33NM
BNN-25        318/FL150
------------------------
<RTE 2 LEGS    RTE DATA>
```

Press the LEGS button and use Page Down if necessary to see what happens after HON. Oho – sure enough, in my case I found a route discontinuity, or ‘disco’, for short (whether or not you get one depends on which database you are using). The FM**C** is saying to us — “**C**ould you please confirm how you want to join the two together?”. So we will.

Quite obviously, once everything is fixed the page *should* read LOVEL — HON — BNN-25, but at present it doesn’t. All we need to do, therefore, is to click alongside the LSK opposite the waypoint we want to move into the boxes (which is obviously BNN-25, as shown on the right), to get it into the scratchpad, and then click on the LSK opposite the boxes to produce the result we want. Once again, as the second screenshot shows, the EXE**C**ecute button lights up so that we can confirm that this is really want we want, so we press that, too.



```
  ACT RTE 1 LEGS      2/5
 163°      14NM
LOVEL         .876/FL280
 163°      58NM
HON           318/15350
 THEN
□□□□□
-- ROUTE DISCONTINUITY -
HON           318/FL150A
 143°      33NM
BNN-25        318/FL150
------------------------
<RTE 2 LEGS    RTE DATA>
BNN-25
```

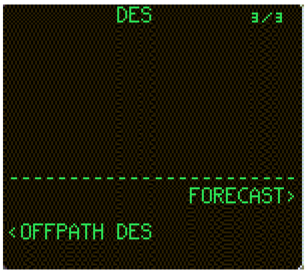


```
  MOD RTE 1 LEGS      2/4
 163°      14NM
LOVEL         .876/FL280
 163°      58NM
HON           318/FL248
 143°      33NM
BNN-25        318/FL150
 143°       7NM
WCO          240/ 7000A
 120°      17NM
BNN          240/ 7000
------------------------
<ERASE         RTE DATA>
```

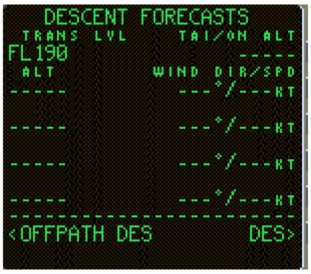
So now we have fixed our route — or have we? As I said before, “It’s always highly recommended to check the route through visually . . . .”, and if that doesn’t ring a bell, then please revisit page 33 to find how you use PLN mode to step through the route and ensure that it is as expected.

Ah — *at last* we have sorted out the FM**C** for our landing (unless, of course, our friends in AT**C** intervene again). But there’s more to do yet!

You remember setting the NAI to AUTO earlier? We know from the details we got during pre-flight that this will turn on when cloud is encountered at 21,000 feet, so we need to let the FM**C** know about that, too, so that it can take into account the higher idle speed required when it makes its descent calculations. And also, we need to let it know about the winds during the descent.



```
         DES          3/3








------------------------
               FORECAST>
<OFFPATH DES
```

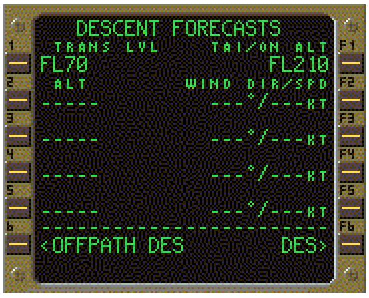


```
   DESCENT FORECASTS
 TRANS LVL     TAI/ON ALT
FL190               -----
 ALT        WIND DIR/SPD
-----           ---°/---KT

-----           ---°/---KT

-----           ---°/---KT

-----           ---°/---KT
------------------------
<OFFPATH DES         DES>
```

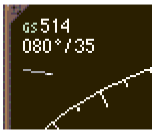
Press the FM**C** VNAV button (and use Next or Prev page if required to reach the DEScent page), then press LSK 5R (or use <F5>) to get to the Forecast page. The first thing that we check is whether the

Transition Level is correct, and if not we type the value we wish to use (70) into the scratchpad and press LSK 1L.

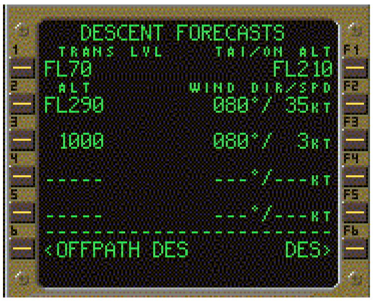
If we need it (and as we now know, we do on this trip), we also enter the altitude at which thermal anti-ice (TAI) is planned to be used. Type 210 into the scratchpad and press 1R. We have now confirmed the Transition Level and the TAI ON altitude and we're ready to enter the forecasted winds during the descent.



```
   DESCENT FORECASTS
TRANS LVL      TAI/ON ALT
FL70                FL210
ALT         WIND DIR/SPD
-----          ---°/---KT
-----          ---°/---KT
-----          ---°/---KT
-----          ---°/---KT
------------------------
<OFFPATH DES         DES>
```



Let's enter the winds at 29,000 ft — watching the ND for a few seconds showed that in my case they seemed to average out at around 35 kts at 080° — so we enter 290 into the scratchpad and click 2L, then type 080/35 and click 2R. We also need to repeat the exercise for the 3 kt wind at Heathrow: but although we know that Heathrow is at 80 ft, the lowest the Descent Forecast page will accept (in PS1, anyway) is 1,000 ft. So type 1000 into the scratchpad and click 3L, then type 080/3 and click 3R. The result should be something similar to the example on the right, and VNAV should now be able to compute a reasonably accurate descent profile for us.



```
   DESCENT FORECASTS
TRANS LVL      TAI/ON ALT
FL70                FL210
ALT         WIND DIR/SPD
FL290          080°/ 35KT
 1000          080°/  3KT
-----          ---°/---KT
-----          ---°/---KT
------------------------
<OFFPATH DES         DES>
```

Fortunately, all this takes far longer to describe than it does to do!

There are a few other jobs to take care of . . . . ☺ :—

- Having checked ATIS you now also know the baro setting to be used (1011 mb), and you need to pre-select it so that the altimeter will correctly register your height above Mean Sea Level (QNH) — your altitude. (This barometric adjustment is done by left (decrement) clicking or right (increment) clicking to the right of the STD button on the left of the glareshield). The new setting appears in white at the bottom left-hand corner of the PFD, so that when you switch out of STD mode your barometric pressure will be correctly set for the current conditions. Hardy adds: "The Approach Checklist is often called soon after passing Transition Level (at which point QNH should be **set**), and the most important item on that list — because it's deadly if the crew forgets it — is 'Altimeters Checked *and Set*'. Not only preselected but (at that point) correctly *set*!"

- Check that the correct landing altitude is displayed at the bottom of the upper EICAS.

- Press the button for the Nav Rad FMC page and check whether the necessary ILS frequency is shown (Parked, ready for automatic activation later): if not, you would have to find the ILS frequency and runway heading for Heathrow's 09L from the Airport Info on the Instructor's Page and enter them into the scratchpad (110.30/094 [67]), then press <4> to load them as a manual entry.

---

[66] Earlier in the Tutorial, we defined icing conditions as "a temperature of less than 12°, combined with rain (or fog or cloud)", so we are right on the borderline here (the temperature outside right now is -18° C (check the PROGress page 2 of 2, and don't confuse this with the TAT shown at the top of the upper EICAS: see Hardy's explanation on page 40), but it will warm up as we descend (rule of thumb — by 2° per 1000 feet), reaching 12° at Heathrow's ground level.

[67] Although modern charts give it as 093°, the database on the PS1 CD expects 094°!

- If you are going for an Autoland (as most of the users of this Tutorial will be — at least initially), you now need to left click to the left of the RST button on the left-most panel of the glareshield so that the needle points to DH (Decision Height — all **C**at II or III approaches must be AutoLand). Then right click to the right of the RST button until you have set the DH to whatever is shown on the **C**hart, in readiness [68] (100 ft, in this case). This is a *height*, remember, so we're talking 100 ft AGL — Above Ground Level. [69] If by any chance an MDA is set, remove it by setting it to below -1000 ft.

  Around 50 nm before the Top of Descent point:—

- Set the autobrakes to 3 (carbon brakes work better, and wear less, when they're hot).
- Set the seatbelt signs to ON. (<M>)
- Press INIT REF to reach the Approach Ref page and verify V_{REF} for the current weight. The runway is wet, so although there's lots of it at Heathrow (12,802 ft, as you can see from the Approach Ref page of the FM**C**), you may prefer to opt for flaps 30. In this case, click LSK 1R to transfer the flaps 30 figures into the scratchpad, and then click 4R to transfer them into the FLAP/SPEED line. (N.B. *It will not change once you have selected it*, so if you subsequently encounter a long hold you will need to reselect the REF speed to accommodate the changed aircraft weight — see later).
- Select the PROGress page so that you can monitor the distance to T/D.
- Review your Approach Briefing [70]

That last item in the list looks unassuming, but it's your opportunity to get clearly in your mind everything that you want to happen prior to turning off onto the taxiway after a smooth landing. Just as in the briefing before take-off, it's helpful to brief yourself as if you were addressing the crew (which, of course, you are — not to mention the **C**ockpit Voice Recorder ☺). You might want to say something like this:—

"We will request descent clearance in (*however many — see the PROGress page distance to T/D and deduct 20 miles or so*) miles' time. We will descend in VNAV for a Bovingdon One Alpha Star followed by an ILS **C**at II Autoland approach into Heathrow runway zero niner left. This is Heathrow, so we need to be prepared for the possibility of a hold, most probably at Bovingdon. In the descent we will use 7,000 ft as the Minimum Safe Altitude until we pass Bovingdon, when we will use 2,300 ft which is the height of the highest ground to the east of the airfield [72].

---

[68] The PS1.3 manual helpfully summarises the various **C**ATegories of ILS signal quality on page 242: read this in conjunction with your Approach **C**hart. Autoland is approved for **C**at II and **C**at III approaches, requiring a minimum of two and three functioning autopilots respectively, and **C**at III is further subdivided into IIIa, IIIb, and IIIc in increasing order of sophistication and decreasing order of the minimum visibility required. **C**at III is available at Heathrow 09L, as the Approach **C**hart tells us.

[69] Once you are able to fly an approach manually you may use an MDA (Minimum Descent Altitude) — i.e. *you may descend below this height only if you have the runway in sight and you are flying an ILS CAT I or non-precision approach.* (To set an MDA right click to the left of the RST button so that the arrow points to MDA and not DH. Then right click (increment) or left click (decrement) to set the MDA — which would be 280 ft MSL (QNH), it's an *altitude* — for a **Cat I** ILS in this case). If you are at all unsure about the differences between DH and MDA, I would urge you to study the diagram which Hardy has kindly produced to clearly illustrate these differences — see Appendix 1 on page 71.

[70] Don't confuse the Approach *Briefing* (which is long and takes place miles before the Top of Descent) with the Approach *Checklist* (which is quite short since you will be quite busy at the time, and which is called for much later — normally soon after having passed Transition Level).

[72] See the bottom right hand corner of both the STAR and the Approach plate.

"As to the descent profile: we are at present routing to Honiley where the STAR begins, and our computed Top of Descent is shortly before we arrive at Honiley. We need to cross the 25 nm DME radial from Bovingdon at 15,000 ft, and to observe the Speed Limit Point at WCO of a maximum of 250 Kts IAS. We also need to ensure that we are at FL 70 or above when we arrive at Bovingdon, to stay clear of departing traffic. At Bovingdon there may be the usual hold, in which case we will slow to our best holding speed below the limit of 220 KIAS. After Bovingdon we fly 222° as shown on the Approach Plate: recalling that the procedure is based on a maximum of 220 kts, we should aim to be at 180 kts or even less by the time we start to turn left to follow the localiser; starting the turn at 15 nm DME from Bovingdon. The altitude and speed restrictions are in the FMC.

"The ILS for runway 09L is IAA on a frequency of 110.30, which is entered on the Nav Rad page. The ILS has a standard 3° glideslope, which we will follow down to the minimum for a Cat II Autoland which is a Decision Height of 100 ft. We will be inbound on a course of 094° [73] following the localizer. The final approach fix is 7.5 DME from IAA, at which point we should intercept the glideslope at 2,500 ft (CF09L on the FMC). As we follow the glideslope we should be at 1400 ft at the Final Approach Fix 4 DME from 09L (CF09L on the FMC) [74] and in view of the weather and the requirements of this Tutorial we shall make a flaps 30, autobrakes 3, Cat II Autoland.

"In the event that we have to do a go-around, the missed approach procedure is to climb on 040° to an altitude of 3,000 ft, and then proceed under ATC direction, also as in the FMC. The alternate is Gatwick, the fuel for which is loaded [75]. Our current weight gives us a V_{REF} for flaps 30 of (*whatever the Approach Ref page tells you*) kts, and the Heathrow ATIS gave us a QNH of 1011 millibars which has been pre-selected".

You may feel self-conscious about rehearsing the approach (usually to yourself, with PS1) in this manner, but if you get into the habit of doing so it really does help to ensure that you have thoroughly studied the charts and are clear in your mind not only about what *you* are going to do, but also (and crucially) that the relevant constraints are all entered into the FMC.

To assist the deceleration, if would be helpful to enter the speed restriction information into the DES page (even though it is already in the LEGS page). To do this:—

- Press the VNAV button on the CDU, type 250/15000 into the scratchpad, then press LSK 4L and EXEC to enter it into the SPD RESTR (Speed Restriction) line. If you keep an eye on the unlabelled green ring on the N/D (your deceleration point) you may notice it move smartly backwards upon the receipt of this information, so as to start the deceleration earlier.

---

[73] As mentioned above, the current charts give 093°, but be aware that in this case PS1's localizer (see the Airport Information page) uses 094°, and so we will, too!

[74] Hardy has named the FMC waypoints in accordance with the Jeppesen/Honeywell FMC waypoint naming convention: "D222D" is BNN bearing 222°, 4 DME (since D is the 4th letter in the alphabet): "D222O" is BNN bearing 222°, 15 DME (O [Oscar, not Zero] is the 15th letter in the alphabet): "CI09L" is the Initial Approach Course Fix, Rwy 09L: "CF09L" is the Final Approach Course Fix, Rwy 09L: and "MA09L" is the Missed Approach Point, Rwy 09L.

[75] If the weather at Heathrow had been at all marginal, we would no doubt have given some additional thought to the Gatwick approach, setting it up (at least partially) in RTE 2.

About 2 - 3 minutes before the Top Of Descent point:—

- **Reset the MCP altitude** to the initial altitude constraint on the STAR you will be flying — BNN1A here — or if you are not following a STAR set it to the Outer Marker or Final Approach Fix. So in this case we need to set FL150 for the constraint at BNN-25.

Hardy comments: “Your currently ‘planned’ altitude should always agree with your selected altitude bug. (On every aircraft. That's ‘IFR’)”.

- Verify the V_{REF} speed for your *landing* weight: obviously we will have burned up a little more fuel by the time we land and will therefore be somewhat lighter, thus reducing V_{REF} slightly. The difference will obviously be fairly small if we are near T/D and are about to begin a descent at idle thrust more or less straight in to the runway, but it could be significant if we have to spend half an hour getting dizzy in a hold, for example, in which case we would probably re-check it every ten minutes or so.

Descent

- Verify that at the T/D the autothrottle mode indicator at the top left of the PFD changes from SPD to IDLE and then HOLD.
- Press VNAV, and verify that the VNAV DES page (ACT ECON DES) is displayed.
- Check the position of the unlabelled green ring on magenta line of our path as displayed on the ND — this is where we anticipate ending the deceleration for the Speed Limit Point.

Whilst you’re there, so to speak, press LSK 6R (FORECAST) and confirm that the Transition Level is correctly entered. (Return to LEGS to monitor the descent).

- Don’t worry too much about the VNAV deviation pointer (in white, towards the bottom right of the ND). You will find that it often sits somewhere around the middle of the scale, except when decelerations are taking place. The scale reads plus or minus 400 ft from the desired path, so if the diamond sits at the bottom of the scale it is thinking that you really should be at least 400 ft lower (small white figures will tell you when it thinks you need to be lower still). But in general, as long as you have correctly told the FMC about descent winds and TAI you should (especially in 1.3a) achieve the best descent profile without the use of the speedbrakes. If that comes as a surprise, let me quote Hardy on this:—

  “Don’t chase the path indicator during decelerations — it is not clever enough to take the decelerations correctly into account. *You don’t need the speedbrakes*”. (My italics ☺).

  Since being made aware of this, I now confine my use of the speedbrakes purely to *some* occasions — “pilot’s discretion” ☺ — when the “DRAG REQUIRED” message appears in the FMC.

- Check the switch and select Continuous Ignition if turbulence or heavy precipitation are expected [76] (*ENGINE START + FUEL panel*) — otherwise engine failure could occur.

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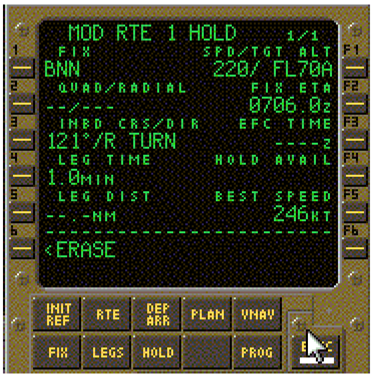
[76] Which, given the Weather page we saw for Heathrow, is certainly the case in this Tutorial!

I've just heard from ATC again, incidentally [77], who have given us the expected instruction to enter the hold at BNN (remaining at FL70 in the hold until released). This means a little bit of work to do to tell the FMC about the change of plan (the 250 kt speed restriction at BNN25 still applies, however, so we will leave that constraint in place).

A look at the chart (in Appendix 14) gives us the information that the holding speed in the London TMA is "MAX IAS 220KT below FL 140". So the first thing we need to do is change the line in the legs page which gives us 250 kts at or above FL70 at BNN. To do this, we simply enter 220/ into the scratchpad (the concluding slash is mandatory) and press the LSK opposite the BNN constraint. So far so good.

There may well be another action which will be required, however: with a current V_{REF} of around 140 kts and a minimum manœuvring speed with flaps up of V_{REF}30+80 (see Appendix 10), 220 kts (or less) at our current weight is going to be right on the borderline for a clean configuration, so we will need to be at flaps 1 when we slow towards that figure (and in the hold itself). *We can't extend the flaps yet, though* — as you will also recall from Appendix 10 [78] the placard speed for flaps 1 is 280 kts, and we are currently descending at 300 kts. So we must defer flaps 1 until nearer the hold. What's more, being at flaps 1 will then change our best holding speed, and we will need to re-check this on the hold page and make the necessary adjustment once we have flaps 1 selected. (So make a mental note for later on).

We can set up the hold itself in a preliminary way, though, since we already have much of the information we need. Press the HOLD button, and you will be presented with a list of waypoints from which to choose. Click the LSK next to BNN to transfer it to the scratchpad, then click next to the boxes to enter it. You will now be presented with the Hold page itself, with the Execute button illuminated to remind you to confirm your changes before leaving this screen.



```
   MOD RTE 1 HOLD        1/1
 FIX              SPD/TGT ALT
BNN                220/ FL70A
 QUAD/RADIAL          FIX ETA
--/---                0706.0z
 INBD CRS/DIR        EFC TIME
121°/R TURN             ----z
 LEG TIME          HOLD AVAIL
1.0MIN
 LEG DIST          BEST SPEED
--.-NM                  246KT
-----------------------------
<ERASE
```

A comparison of the details on the screen with the details of the hold as shown on the STAR shows that the FMC seems to have got most of the details right. We *will* be inbound on 121°; it *is* right turns; and the speed and target altitude information has been copied from the BNN information on the LEGS page. The only slight snag is that our best speed is shown in this example as 246 kts — which is for our current (clean) configuration and will be incorrect when we are at flaps 1. But this we will fix before we arrive at the hold, so for now we simply Execute the changes.

Shortly after we enter the cloud at 21,000 ft (you will see the blue sky in the outside view become a fuzzy grey) the NAI should switch on (we set it to AUTO — if it doesn't come on, then switch it on manually). You will notice that the engines also spool up a little to 'high idle' to provide the necessary warm air for the anti-icing function — from an EPR of 0.98 to around 1.11, in my case.

This is probably a good time to change the ND scale to 40 miles.

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[77] "Hold at BNN as published. Descend and maintain FL070". At least they didn't wait until we were right on top of the hold before telling us (it happens!). ☺

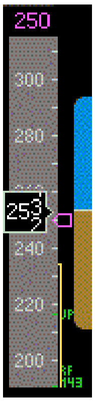
[78] Are you getting the distinct impression that a thorough understanding of Appendix 10 is quite important? ☺

By the way — are you still remembering to adjust the heading knob at each waypoint? ☺

As we near the green circle this side of BNN25 you will notice that the aircraft begins to decelerate, aiming for our target of 250 Kts at FL 150. The vertical deviation indicator will start to move again — but don't worry, all will be well.

If you check above the altimeter tape you will see our current altitude constraint (15000) in purple. As we approach that altitude and the figure "15000" becomes visible on the tape itself, you will see a corresponding purple marker there, too.

You can now preselect 7000 in the ALT window, and as soon as BNN25 disappears from the top of the LEGS page the descent will start automatically. (If you didn't change the MCP altitude previously, dial up 7000 now and press the knob to initiate the descent). Notice that the action of pushing the knob automatically removes the constraint at WCO, incidentally. It would be a kindness to inform the FMC about our new speed restriction at this point, so press the VNAV button, type 220/7000 into the scratchpad and press LSK 4L again, to insert it. Execute your change.



A glance at the PFD (as shown on the left) now confirms our previous suspicion that we will definitely need flaps 1 to fly the hold at our best speed below 220 kts (notice also that the Ref speed is visible at the bottom of the speed tape).

Don't forget to turn on your landing lights as you pass FL100!

As you get nearer to BNN this is a good time to change the ND scale to 20 miles, and watch for the aircraft beginning to decelerate from 250 kts towards 220. This is the time to:—

- Select flaps 1

. . . . and also time to sort out your best speed for the hold, so press the HOLD button to return to the Hold page.

Now that flaps 1 has been selected, we are given a new Best Speed (211 kts, in my case). You should now enter 211/ (or whatever value it may be for your weight — again, you need the concluding slash) into the scratchpad and click on LSK 1R. Execute your change. Press the LEGS button and you should find that the constraint for the BNN hold line (but not the one for BNN itself) has also been updated with this information.

Notice that the size of the hold displayed on the ND suddenly gets larger as you get near it: if you got everything right the speed constraints and hold details will take effect automatically, and you will start to go around the 'racetrack' under the control of the FMC.

With a totally clean descent you may well have entered the hold at around FL 110, but if so you should nevertheless find that you will have achieved FL70 before completing a single circuit of the racetrack — this is the reason why the procedure is designed that way, and why Hardy made the constraint at BNN an "At *or Above*" one. So fairly soon you should be at FL70 as directed by ATC, and doing your best speed below the 220 kt limit.

Just as the aircraft completes its second 180° turn to head back towards BNN, ATC clears us for our Cat II approach to Heathrow [79].

(Assuming you are at FL70, of course), press the HOLD button again, and click LSK 6R where it says "EXIT HOLD", and Execute the change. (The prompt now reads "EXIT ARMED"). So the next time you pass BNN you are going to exit the hold and resume the flight plan in the FMC.

Whilst the FMC is sorting all that out for you, press LEGS and have a look at the waypoints and constraints which follow. You need to be at FL70-or-above at D222D, but will then want to start to descend to 2500 ft at CF09L. So now you should dial up 2500 in the ALT window before reaching D222D in order to begin the descent as planned. (If you have already passed that waypoint, you will as usual need to press the knob after dialling up the new figure). Note that since FL70 is the Transition Level, you will therefore need to remember to switch from STD to local barometric pressure as you pass D222D and start to descend below the TL (you preselected the pressure to be used previously, you may recall), although the yellow box with STD in it which appears at the bottom of the altitude tape is a fairly effective reminder should you forget!

Press the RCL button to check that you haven't missed anything whilst you've been so busy. In Hardy's words: "If a failure has been detected, verify that the appropriate action has been taken and that the crew are aware of the possible consequences".

Since we have gone round the hold at least once, it is a good idea at this point to press INIT REF to revisit the Approach Ref page and re-check your V_{REF} speed for the intended landing flap of 30, and that this agrees with the REF speed shown at the bottom of the speed tape in green. This speed also, of course, gives you the corresponding speeds at your current weight for increasing amounts of flap, as discussed in Appendix 10. In the early days you might want to take a few moments to fix these in your mind, although the green marks on the speed tape are a pretty good guide. ☺

Having passed through the TL and verified the correct pressure has been set, press V and —

run the BA APPROACH checklist.

OK, let's select flaps 5 straight away, recalling that the time required to get from flaps 1 to flaps 5 is significant. Once flaps 5 is safely achieved, then you can reduce speed down to V_{REF}30+40 knots. To do this, we use what is grandly termed Speed Intervention, but which consists simply of pressing the IAS/MACH knob to open the window, then rotating the figures to the desired value. This overrides the figures in the FMC, and our speed begins to reduce.

We now call for flaps 10 before reaching the turn, but this time when this has been achieved instead of reducing to V_{REF}30+20 knots as stated in Appendix 10, we only use V_{REF}30+30. Why? Because we need that extra 10 knots to allow for the reduction in stall speed which takes place during a turn: once we are flying in a straight line towards the runway we can back off the other 10 knots.

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[79] Although the chart shown in Appendix 14 is not specifically for Cat II ILSDME, it is virtually identical in its details.

ILS approach

You should be able to see the ILS identifier (IAA in this case, as mentioned in the Approach Briefing) in white letters near the top left of the PFD, and below that “DME xx.x” with the straight-line distance to go.

When you’re near C109L (i.e. just about to begin the turn), press the LOC button on the MCP to arm Localizer mode (you should see LOC in white letters on the PFD, indicating its armed status). As we complete the turn, this action should ensure that we end up pointing straight at Heathrow’s runway 09L. When we do capture the localizer, LNAV will be disengaged. Therefore beware — *if the LOC annunciation does not change to green it means that you have **remained** in LNAV mode and have **not** captured the localizer*, and may therefore be flying just parallel to it (in which case you will *never* capture it, so you need to nudge your course slightly to intercept it).

As you complete the turn (your F/O will warn you when the Localizer becomes active) check on the PFD that LOC mode becomes engaged (green). You can now lose that extra 10 knots of speed, too. (You also remembered to adjust the heading knob accordingly, didn’t you? Of course you did).

You can now select gear down and flaps 20: flaps 20 is achieved quite quickly, so then reduce speed to V_{REF}30+10.

You should now be flying at 2,500 ft and be about to engage the glideslope from below (i.e. the G/S diamond is about one dot *above* the centre of the scale on the PFD). So press the APP button to select full approach mode. When you see G/S annunciated in green then you know you have captured the glideslope, too: select flaps 25 (which is quickly achieved) and then flaps 30. Once at flaps 30 you can reduce speed to V_{REF}30 [80].

You’re looking good but there’s still three important jobs to do now:—

- Arm the speedbrakes (<F8>).
- Set the MCP to the missed approach altitude of 3000 ft.
- *Run the BA* LANDING *checklist.*

Finals

Now check that the FMC is not in input mode (so that you can quickly engage reverse thrust using the backspace key on landing — a purely PS1 check ☺) and hover the mouse pointer over the TOGA button ready for any eventuality which might make you execute a go-around. You might reset the ND range to 10 miles, too, if you haven’t already done so.

In fact, the runway comes into view remarkably quickly (there must be a momentary pause between the rain showers) so barring any unexpected failures you can feel fairly confident about landing. Nevertheless, at the Decision Height of 100 feet your F/O will say “Decide!”.

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[80] It would be (V_{REF}30 + 5 kts + half the headwind component) if we were not making an Autoland.

Assuming that the runway is still in sight and all is well, you respond “Land!!”, and very shortly thereafter your tyres kiss the surface of the 09L runway at Heathrow.

Landing

- The throttles will automatically be set to idle — if you have hardware throttles you should also back this up manually.
- Apply reverse thrust <backspace key> immediately after touchdown until the F/O announces that 80 knots has been reached, then press backspace again to disengage.
- Confirm the Speedbrake extension (verify the knob travelling downwards — if it doesn’t, extend the speedbrakes manually).
- Monitor Autobrake performance, applying additional braking if you’re in any danger of running off the end of the runway. (!!)
- Disengage the Autopilot (press <A> *twice*) at 30 kts.
- Tap the space bar (both brakes) to disengage the autobrakes, too, and then use the brakes as required to slow down to 15 kts, ready to turn off the runway.
- Turn off the runway and start to taxy towards the gate.

Leaving the Runway

There’s quite a bit to do, still — don’t forget to steer the aircraft whilst you’re doing this section!

- Set the autothrottle arm switch off (<T>).
- Press <F7> enough times to completely retract the speedbrakes, so that the lever is back to the Dn position.
- Turn your landing lights and strobes off (as a kindness to fellow pilots, marshallers, and everyone else out there on the apron) but leave your beacon and nav lights on for now. *(MISC panel)*
- Turn the weather radar off (mandatory, and also a kindness . . . .).
- Set the Flight Director switch off (<F>).
- Press <F9> a sufficient number of times to bring the Flaps lever to the UP position.
- Set the Stabilizer Trim control to 6 units

At this point, run the BA AFTER LANDING *checklist.*

IF the APU is required (if not, go to “Parking and shutdown”):—

  - **Press** the EICAS "STAT" display button (first moving your mouse to the right hand side of the glareshield, if the buttons are not visible).

  Return to the *ELECTRICAL panel* —

  - **ROTATE** the APU selector through ON to START, and release back to ON. Wait, and within 30 seconds or so the AVAIL lights will illuminate. (Watch the STAT synoptic’s APU EGT figures if you want to see the exhaust gas temperature rising).
  - When you see the “APU RUNNING” message in white in the upper EICAS display, check that the APU GEN 1 and APU GEN 2 lights are illuminated on the Electrical panel, then **press** the ON button on either APU GEN 1 or APU GEN 2 (next to the

'AVAIL' indicator, but *not both together*) to activate the associated generator to power the aircraft prior to engine start. Verify the ON light illuminates and the AVAIL light goes out. Action the other APU button also (after a pause).

- Check that both APU GEN 1 and APU GEN 2 switches are now showing ON lights.

Parking and shutdown

- Apply the parking brake (<B>).
- If the APU is off and ground/external power is available and required, select EXT ON. (If the APU is on and you wish to switch to ground power, then select EXT ON first and then turn the APU off).
- Select the DRS synoptic view.
- Turn the beacon off (*MISC panel)*. (It's a 3-position switch in this config, remember — don't just click it once and set it to 'Lower').
- Turn the seatbelt sign to OFF to release the pax.
- If the APU is started or you have external power, go to the *Pneumatics panel* and turn the packs ON (while the passengers are leaving — the reason for needing power at this point is to keep the air conditioning running this chilly London morning).
- On the *MISC panel*, check that the Nacelle and Wing anti-ice switches are set to AUTO and OFF, respectively.
- Move the fuel switches to Cutoff in the sequence 1, 2, 3, 4.
- Turn all fuel pump and override switches off (*Engine and fuel panel*). [81]
- If Continuous Ignition is still on, turn that off, too.
- Ensure that all exterior lights are off, except for the Nav lights.
- On the *PNEUMATICS panel,* check that the equipment cooling selector is set to NORM.
- Also on the *PNEUMATICS panel*, leave the L and R isolation switches ON (white bar visible).
- Check for an even distribution of the brake temperatures on the GEAR synoptic [82].
- Check the IRS error. Set the ND in MAP mode with CTR pressed and the range set to 40 miles, then press POS and see how close together the "stars" are to the "triangle" (indicating the individual IRS positions relative to the FMC position). Zoom in to a 10 mile range to ensure that they are all reasonably close, then press POS again.
- Go to the EEC+IRS panel and turn all three IRS selectors to OFF.
- Turn all exterior and emergency lights off (*MISC panel*).

Perform the BA SHUTDOWN *checklist* (as before, ignore the Aft Cargo heat item ☺)

Leaving the Aircraft

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[81] Hardy's succinct comment about this phase: "Turn OFF all Hydraulic Demand pumps, but leave all ENG hydraulic pump switches and all ENG Bleed air switches ON".

[82] If there had been any fire down there, you would have received an EICAS message about it before now!

This next section is only performed if, rather than leaving the aircraft in a "lukewarm" state for the next crew, you are going to completely shut it down to the "cold and dark" condition at the very beginning of the Tutorial (doesn't that seem a long time ago? ☺).

OK, the pax and cabin crew have left, and you've done all the remaining paperwork . . . .

- Go to the *PNEUMATICS panel*, and set all three pack selectors off.
- If the APU is running, go to the *Electrical panel* and turn the APU Selector switch to OFF to shut it down.
- If the APU has been running, wait for two minutes after APU shutdown to allow for fire protection.
- Turn the Standby power selector OFF and the Battery switch OFF.

Perform the BA ***SECURE*** *checklist*

At last!

Congratulations!

That was a busy flight, **C**aptain, but you made it! ☺

So now my task is almost done. But whilst you pour yourself that well-deserved drink and relax, please allow me in closing to mention just one more (rather lovely) thing — *this is only the beginning*. PS1, probably uniquely amongst the flight sim world, has a plethora of add-ons most of which, like this Tutorial, are free. (I don't need to make the obvious point about how much users of the Microsoft Flight Sim have to spend every time they want to add anything at all to their simulation experience ☺).

If you would like to fly with real human beings acting as AT**C** for your flight (via the internet), all that is well documented and available. If you would like to join a Virtual Airline and work your way up through the ranks, you can do that too. Or perhaps you'd simply like to take an aircraft which has been shut down by a previous PS1 **C**aptain and fly it somewhere else in the world — no problem. Want to use the real weather? That's OK, you can get it. Prefer to replace the supplied navigation database with a more up to date version? It's all available online.

You have now joined what many have described as the most friendly and helpful technical community on the planet — just point your browser at http://aerowinx.com/ and check out the forum. But while you're there, look at the free downloads which are available in http://aerowinx.com/html/miscellaneous.html — you will find all sorts of goodies: new aircraft configuration files; new AT**C** voices; an add-on to allow you to taxy around real airport layouts; fuel and route planners; a database of over 8,000 airport gates for your FM**C**; the ability to update or add completely new airports to your database . . . . And there are other sections of the site with videos for you to download; SIDs, STARs and Routes; FAQs; — even a chat room.

But there are a number of sites elsewhere, too, some of which I have mentioned during the Tutorial — perhaps notably Jeroen's at http://infolab.kub.nl/people/hoppie/ps1/. Here you will find the source of some of the goodies mentioned above such as the Gate database, FlightLine, and weather injection, and of course the indispensable Broker — but also much other interesting stuff including the ability to hear Flight Crew announcements at the appropriate phase of flight (good fun), right down to the 1.2c version of this Tutorial.

Space (not to mention the rate at which internet URLs tend to change) prevents me from mentioning many more, although http://members.ozemail.com.au/~iriddell/bigc.html is also a must — here Ian Riddell has his 'Boeing 747-400 Cockpit tutorials' which will add to your knowledge of the 747-400 — and don't miss Markus's site with 17538 SID/STARs for 516 airports: http://www.tp1.physik.uni-erlangen.de/~vitzethum/ps1/navdata/.

So congratulations to you are doubly in order — not only for managing to work your way through the Tutorial ☺ , but also for having had the brilliance to join the talented and friendly bunch of people which is the PS1 community world-wide.

But before leaving you I must once again put on record my personal thanks to Hardy Heinlin: mainly for providing us with such a superb simulation of the 747-400, of course — but specifically for his guidance and expertise during the writing of this Tutorial, without which it would have been much the poorer.

So it's finally time to say Farewell. I do hope that you've found this Tutorial helpful, and that it's given you a flying start (oops, sorry ☺) at understanding some of PS1's joys and complexities. If that is the case, then I can feel that my time has been well spent!

Clear skies, Captain!

Brian

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May 2000 to August 2001. (Password changes and minor typo fixes, March 2002).